Aid for and trade with Africa: impact on economic growth. Are we ready to choose yet?

by

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Biographic note

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Abstract

By using a panel of 48 countries from the year 1976 to 2015 this dissertation estimates the impact of aid and trade on economic growth in Africa. The main findings show that trade has a positive and significant effect on economic growth in Africa regardless of the different methodologies used in the analysis. In addition, aid has a negative and significant effect on economic growth under the cross-sectional study and the panel estimation of pooled OLS and fixed effect. However, although negative, the impact of aid on economic growth is insignificant under the GMM estimations. This work seems to sustain that Trade has been performing better in promoting economic growth than its counterpart, aid. Hence, focusing on trade relations and how to improve gains from trade is a rather interesting research area in what concerns the study of economic growth in African countries, more relevant than what seems to be a search by the mavens for excuses to justify the inconsistent performance of Aid.

JEL-codes: F35, O1, O4

Key-words: Africa, Aid, Economic growth, Trade openness

Resumo

Ao usar um painel de 48 países para o período temporal 1976 a 2015, esta dissertação estima o impacto da ajuda externa e do comércio internacional sobre o crescimento económico em África. Os principais resultados da dissertação mostram que o comércio tem um efeito positivo e estatisticamente significativo no crescimento económico em África, independentemente da metodologia utilizada na análise. Além disso, a ajuda externa aparece com um efeito negativo e estatisticamente significativo sobre o crescimento económico no estudo *cross-section* e na estimação em painel do Pooled OLS e de efeitos fixos. No entanto, embora negativo, o impacto da ajuda no crescimento económico é não significativo nas estimativas GMM. A presente dissertação sugere que o comércio tem um impacto positivo mais significativo do que a ajuda internacional sobre o crescimento económico. Assim, o enfoque no comércio internacional e nos ganhos associados corresponde a uma área de investigação no âmbito do crescimento económico que parece ser mais relevante do que a procura de justificações por parte dos especialistas para sustentarem a importância da ajuda internacional.

Códigos-JEL:F35, O1, O4.

Palavras-chave: África, Ajuda externa, Crescimento económico, Abertura comercial.

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Chapter One

1. Introduction

For a long time, the key feature of African countries in what concerns the relationship with the outside world has been based on aid (Riddell 1999)). The fact that many of the African countries remain relatively poor even after enormous amount of aid, triggers a question on its effectiveness. But the studies related with this issue are conflicting in their conclusions.

Burnside and Dollar (2000), in the pioneer study as far as directly assessing foreign aid's impact on economic growth concerns, discovered a positive impact of foreign aid on economic growth only effective when the recipient country has good economic policy. However, Easterly et al. (2003), using the same methodology and the same countries, after filling the missing data and adding four years, found no significant relationship between aid and economic policy. The authors don´t argue about the ineffectiveness of aid but simply point out that the findings of one of the most influential paper, Burnside and Dollar (2000), are not robust.

On the other hand, Chang and Mendy (2012) found that foreign aid has a negative relationship with the growth rate of GDP. Hossain and Mitra (2013) suggests that, while there is no causal relationship between economic growth and foreign aid in the short run, aid has a significant negative effect in the long run. The author sustains that this negative long-term effect could be due to bad economic policy in the recipient country.

Arndt et al. (2009) consider those studies which conclude that foreign aid has a negative impact on economic growth as 'pessimistic'. The authors argue that policy orientations of a measure such as the complete cessation of aid to Africa are being drawn on the basis of insubstantial evidence. Their finding shows that aid has a positive and statistically significant casual effect on growth over the long run. They conclude that aid remains an imperative instrument for improving the development prospects of developing countries.

Openness to global market is an essential element of any pro-growth

reform package. In addition to constraining countries from implementing policies that work against growth that would also lead to problems with foreign payment or exchange rate crisis, trade openness allows technological diffusion from other countries, challenge local monopolies and, more importantly, stimulates more efficient allocation of resources (Sachs and Warner 1997).

'Afro pessimism', representing Africa as associated with economic decline, social disorganization and political collapse, was a dominant idea in most of the northern scholars, policy makers and media, as pointed out by Martin (2008). This viewpoint might explain why Africa was not invited to be engaged in the global economy for a longtime. The international trade agreements like the Uruguay Round behold a very low benefit for Africa and African countries (Harrold (1995)). But recently new bilateral and multilateral trade agreements have been signed between Africa and other countries.[1] The literature concerning trade is also conflicting. Clemens and Williamson (2001) suggest that African economies were able to grow faster when they have a protectionist policy, whereas Watkins and Fowler (2002); Dowrick and Golley (2004) show openness to trade is not beneficial for countries that export mainly primary goods. Some other studies e.g., Chang and Mendy (2012); Adam and O'Connell (2004) show that openness in trade and investment is positively related to economic growth and open trade is a good preference than external aid.

The main goal of this dissertation is, by analyzing the impact of aid and trade on economic growth, to answer the following question: Which of the variable performs better in promoting economic growth in Africa? By providing an answer to this question, this dissertation aims to be an input to policy makers in both donor and recipient countries.

The dissertation is presented in the following structure. The first section is introduction, providing the motivation, objectives, economic relevance of the research and the contribution to the related scientific area. The second section presents the literature review, which introduces key concepts and shows the

[1] Information gathered from (http://trade.gov/agoa/), accessed on 5 November 2016.

contributions of different scholars on the topic following a chronological order. The third section deals with methodology, data collection and source of data and the fourth section provides the analysis of main results. The fifth and last chapter concludes, also highlighting the main limitations of the present work and future research paths.

Chapter two

2. Literature review

This section briefly reviews the existing theoretical and empirical literature pertained to two most debated topics of economics. The first part of the section deals with foreign aid and growth. The second part deals with trade openness and economic growth. Both parts of this section start from the most important theories on the topics and are followed by reviews of prominent and most important empirical findings in the area.

2.1. Aid and Economic growth

Many theoretical and empirical studies have been conducted to understand whether aid fosters gross domestic product per capita (GDP) growth in the recipient country. It is one of the most debated topic in development economics (Museru et al. 2014).

The most essential aid theories and empirical findings are mentioned in the following part of this dissertation. The theoretical literature review presents the gap models starting from Solow model where aid is expected to fill the saving gap. Next, the Two-Gap model, which incorporates the trade gap and the saving gap is discussed. The Third-gap model which adds fiscal gap on the previous two Two-Gap model is also presented. The empirical literature focuses mainly on studies conducted on African countries, sub group of African countries or a country specific study on one of the countries in the continent.

2.1.1. Theoretical literature review

The earlier literature related with aid and economic growth in developing countries emanates from the post-Keynesian growth model developed by Harrod (1939) and Domar (1946), which usually is known as Harrod-Domar economic growth model. The model can be summarized as follows. In an economy with labor force *L*, capital stock *K*, and output Y; let $\frac{1}{\theta}$ and $\frac{1}{v}$ be the amount of capital and labour the economy needs to produce a unit of output. In this case the economy

will have either excess of labour or excess of capital. Here the assumption is labour is and capital is scarce in a closed economy. Hence, output is $Y = \frac{1}{\theta}K$. The model further assumes that, in a closed economy, investment comes only from saving and saving is a fraction of income, $S = I = sY$. Moreover, change in the capital stock is a result of investment and depreciation, $K_{(t+1)} = K_{(t)} + I_{(t)} - \delta K_{(t)}$. Then the growth rate of capital can be expressed as

$$g_k = \frac{K_{(t+1)} - K_{(t)}}{K_{(t)}} \qquad (2.1)$$

$$g_k = \frac{K_{(t+1)} - K_{(t)}}{K_{(t)}} = \frac{I_{(t)} - \delta K_{(t)}}{K_{(t)}} = \frac{I_{(t)}}{K_{(t)}} - \delta\frac{K_{(t)}}{K_{(t)}} = \frac{sY_{(t)}}{K_{(t)}} - \delta \text{ as } Y = \frac{1}{\theta}K$$

$$g_k = s\frac{\frac{1}{\theta}K_{(t)}}{K_{(t)}} - \delta = \frac{s}{\theta} - \delta \qquad (2.2)$$

$$g = \frac{Y_{(t+1)} - Y_{(t)}}{Y_{(t)}} = \frac{K_{(t+1)} - K_{(t)}}{K_{(t)}} = g_k \qquad (2.3)$$

Hence, assuming that capital is the scarce resource, the growth rate of GDP is the same as the growth rate of capital.

$$g = \frac{s}{\theta} - \delta \qquad (2.4)$$

The first generation of contributions to the aid literature, as classified by Hansen and Tarp (2001), used this model. The observation of the researchers on aid is as an exogenous net increase in the recipient's capital stock. They focused on the link between aid and economic growth by assuming that saving leads to investment and growth as sustained in the above Harrod-Domar model. This is because the studies assumed that a unit increase in aid results in an equivalent amount of increase in investment and saving. Conversely, it means aid is treated as not fungible and will not be spend for the purpose of consumption. The main assumption in those papers is that aid can fill the saving gap when both private and public savings are low.

Following the saving gap model the other prevalent model used to analyze the macroeconomic impact of aid is the Chenery and Strout (1966) Two-Gap model. The model is named Two-Gap model because it incorporates two elements: foreign exchange earnings and domestic saving. In this extended form of Harrod-Domar model the additional gap pointed out by Chenery and Strout is caused due to the inability of developing countries to export vis-à-vis their high imports which results in inadequate foreign exchange. According to the authors, if and when an economy is not able to fill the Saving-Gap and/or Trade-Gap or foreign exchange gap, Aid inflow plays a positive role to increase growth in the economy of the recipient countries.

The other theoretical model of aid is the Third-Gap model. This model was introduced by Bacha (1990). In addition to the foreign exchange Gap and saving Gap, the author incorporated the fiscal Gap. This theory starts from the national accounting identity:

$$Y = C + I + (X - M) \tag{2.5}$$

$$I = (Y - C) + (M - X) \tag{2.6}$$

Separating income, Y, into private income, Y_P, and government income, T, and consumption, C, into private consumption, C_P, and government consumption, G.

$$I = (Y_P - C_P) + (T - G) + (M - X) \tag{2.7}$$

$$I = S_P + (T - G) + (M - X) \tag{2.8}$$

Where Private saving, $S_P = (Y_P - C_P)$

The fiscal constraint, $(T - G)$, is assumed to be the bottleneck for the economic growth of highly indebted countries. They noted that, as debt "lingers" on, rather than overall saving restrictions and foreign exchange constraints, the main cause of economic growth problem originates from limitations in the government budget. This is due to the crowding-in hypothesis, the high role of

investment by central government in basic industries and infrastructure puts an upper limit for profitable private. In conclusion, the main theme of the theory of aid based on gap models is that domestic revenue, saving and foreign exchange can be supplemented by foreign aid.

Unlike the first-generation literature, which evaluated the effectiveness of aid through its impact on saving and investment, the second-generation literature deals with the aid-growth link directly. As discussed above, the first-generation literature assumes aid contributes to capital accumulation through different ways. According to one of the second-generation literature by Levy (1988), accumulation of capital is essential for rapid and sustained growth in an economy. Some of the important roles capital accumulation plays are promoting change in technology and raising the productive capacity. However, from the experience of Sub-Saharan countries failing to grow and sometimes decline in growth in the face of increasing rate of capital accumulation, it is evident that it is not a sufficient condition for having a rapid growth in an economy.

The current literature on aid seems to focus on conditionality of aid. This branch of the literature is not far from having contradictory results as well. The disputation ranges from aid works better in a better policy environment (e.g. (Burnside and Dollar 2000)) to there is no evidence that aid works in a better policy environment or geography (e.g. (Rajan and Subramanian 2008)). Further review of the empirical literature is provided below.

2.1.2. Empirical literature review

A study which related the effectiveness of aid to the political regime of the recipient country was conducted by Boone (1996). The study presents a framework where poverty is a result of distortionary policies introduced by politicians rather than a shortage of capital. In this framework, as long as the politicians receive a follow of aid, it is not in their best interest to adjust distortionary policies. Therefore, aid in this study does not emerge as promoting economic development. The results of the study show that long-term aid programs have little impact on investment and human development. Moreover, the study

acknowledged that aid increases consumption. Yet, the poor in the aid recipient countries do not get benefit from the increased consumption. More importantly, the impact of aid on improving basic measures of human development like primary school enrollment ratio and infant mortality is insignificant.

On the other hand, a study by Hansen and Tarp (2001) found a positive effect of aid on economic growth. The researchers used cross-country growth regressions to assess the association between aid and growth in real GDP. The paper attempts to parallel the results with the results of several other studies on the field. Their findings show that aid in all prospect increases the growth rate and the result holds regardless of the recipient countries policy. While their study found a negative but weak effect on total factor productivity, they reaffirm the hypothesis that aid impacts positively on growth via investment. The study also implied that aid has decreasing returns. According to the authors, the conclusions on the effectiveness of aid can be affected by the choice of the econometric model and the control variables. For example, when they control for investment and human capital. they found no positive effect from aid.

In line with the above research, in the face of the decline in aid for the Pacific and Sub-Saharan Africa during the 1990s, the poverty level had shown an increasing trend. And the fact that the decline in the capacity of aid to reduce poverty has not been compensated by other external finance with development orientation, makes the Millennium Development Goal (MDGs) harder to be achieved. Working on factors which makes the impact of aid on reduction of poverty stronger and sustaining the increase in official aid has a paramount importance for Sub-Saharan Africa in order to achieve the MDGs. Moreover, incorporating other innovative source of external finance which can be seen as augmentation of official aid such as, a global lottery, a global premium bond, special drawing rights and a global environment tax, Tobin tax and the International Finance Facility can be another appropriate response (McGillivray 2005).

Similarly, Arndt et al. (2009) argued that even if the literature concerning

aid and growth hasn't come full circle, researchers on the area come to agreement on the benefit of the methodological advancement. It increases the experts' ability of identifying causal effects in economic phenomena, the application of modern growth theory assisted the formation of reasonable expectation about the return to foreign aid, and the long run outcome of foreign aid on growth will be positive. Their study suggests that during the two periods, 1970-2000 and 1960-2000, on average aid has a positive effect on growth. Even though part of the aid received by the developing countries goes to consumption, the researchers attributed the positive effect of aid to the aggregate investment stimulating capacity and its contribution to productivity growth. The researchers claim that most of the recent literature pessimistic view on aid and its effectiveness towards promoting economic growth is groundless and using those results for designing policy is often unhelpful and inappropriate.

The study also suggested that improving the effectiveness of foreign aid in promoting growth and improving the living standard in the developing countries is a challenge. But, foreign aid is an essential mechanism for increasing development outlook of developing countries. Hence, withstanding foreign aid programs at reasonable levels can foster the living standards of more than a billion of poor people in the world. Eliminating foreign aid, or significantly cutting it back, would be inaccurate and is not justifiable by any sensible interpretation of the empirical data (Arndt et al. 2009).

Gillanders (2011) studied the effectiveness of aid in Sub-Saharan African countries. The researcher employed a panel vector auto regression model to avoid using instrumental variables. The paper analyzed the impact of official development assistance (foreign aid) on human and economic development simultaneously. Based on the study's time path of response, initial success of aid is diminished by later negative responses. The later negative response and the initial success of aid is more evident in a country with good economic policy. The study concludes that, even though it is not in a transformative way, aid does work in terms of generating economic growth.

A study by Ferreira and Simões (2013) tried to analyze the issue of aid effectiveness by dividing the recipient countries, in order to address the problem of sample heterogeneity, as sub-Saharan African countries and Asian countries. The sample is composed of 44 Sub-Saharan African countries and 31 Asian countries, with a time period from 1972 to 2007. While the authors couldn't draw a general conclusion on the effect of the level of financial development and institutional quality and policy variables, due to mixed results reported, they found a negative and significant relationship between aid and growth in each of the regions used as a sample.

The role institutions can play on economic growth is clearly stated in a study by Knack and Keefer (1995). The study shows that only few would dispute that the security of property and contractual rights and the efficiency with which governments manage the delivery of public goods and the creation of government policies, are significant determinants of the speed by which countries economy grow. Moreover, their results indicate the need of more direct indicators, other than political violence and the Gastil political and civil liberty indicators which they deem to be insufficient proxies for the quality of institutions that protect property right, of proper account for the influence of institutions. Protection of property rights are fundamental for growth and investment and institutions providing this protection have a pivotal importance. When they control for investment they found a persistent effect of institutions on growth. This, according to the study, indicates that the security of property rights affects not only the magnitude of investment but also the efficiency of input allocation.

As institutional quality is an essential ingredient to economic growth, this determinant is covered in many other empirical studies exploring the effect of aid such as Birdsall (2007); Gillanders (2011); Young and Sheehan (2014). Institutions are, in fact, considered as one of the channels through which aid might affect growth of an economy.

Young and Sheehan (2014) state that only economic institutions are positively and significantly correlated with growth. They concluded that aid flows

are, ceteris paribus, detrimental to political as well as economic institutions. Hence, aid flows are accompanied with a deterioration in the legal system and property rights of the recipient country and its international trade freedoms. These deteriorations can be associated with large, negative effects on growth.

Further focus has also been given to aid's effect on exchange rate in the form of Dutch disease. The studies by Fielding and Gibson (2012); Adenauer and Vagassky (1998) argued that aid raises consumer expenditure, and this will result in an exchange rate appreciation and, with an ultimate effect, on a shift of resources away from traded goods production and into non-traded goods production. On the other hand, Adam and Bevan (2006) argued that the policy debate on Dutch disease is a short-run phenomenon and it ignores supply-side impact of aid-financed public expenditure.

The related literature on aid and economic growth also presents some country case studies. For example, Adams and Atsu (2014) examined the impact of aid on economic growth in Ghana for the period 1970-2011. They used the autoregressive distributed lag methodology. Despite the difference in the methodology employed, their findings confirms the conclusion by Gillanders (2011), that foreign aid has a positive effect in the short-run but a negative effect in the long run. Moreover, investment and government consumption were significantly related to economic growth, while financial depth and trade did not have a significant impact on economic growth of Ghana. In addition, this study indicates that one-size fits all strategy for the allocation of official development assistance might not be optimal. Another case study is proposed by Tadesse (2011) for Ethiopia using a cointegration analysis. This paper suggests that aid has a positive impact on the economy, but the aid-policy interaction term has a significant negative impact, which makes the overall effect of aid on economic growth to be negative.

Another mostly debated topic related to aid and growth is its conditionality to some country specific factors. Durbarry et al. (1998) used panel data and cross-sectional techniques for 68 developing countries over the period of 1970-93 to

evaluate the impact of aid on economic growth. The study used augmented Fischer-Easterly model in which aid and policy variables are allowed to affect long-run growth rate. The authors suggested that the positive impact of aid flow on economic growth is conditional on stable macroeconomic policy environment, geographical location and income level. However, this positive effect comes when there is an optimal allocation of foreign aid. According to the study, neither low nor high flow of foreign aid results in faster economic growth. The optimum amount of aid suggested in the study is forty to forty-five percent of the total GDP.

More specific conditionality comes from papers such as Burnside and Dollar (2000), Collier and Dollar (2002), Collier and Hoeffler (2004) and Dalgaard et al. (2004) which suggested that the effectiveness of aid depends on, respectively, the quality of policy, poverty-efficient allocation, social policy (more than macroeconomic policy) and climate-related conditions.

On the other hand, cross-sectional and panel data analysis from Rajan and Subramanian (2008) which used generalized method of moments (GMM) estimation found it hard to find a systematic effect of aid on growth. Their cross-sectional analysis shows no robust evidence of a positive or negative relationship between foreign aid flow and economic growth. According to Rajan and Subramanian (2008), their conclusion holds across panel and cross-section contexts, the use of aid received by the country, the time period and the source of aid. In addition, they found no evidence which supports the assertion that some forms of aid work better than others or aid work better in a better geographical environment or with a better policy by the recipient country.

2.2. Trade and Economic growth

Like the theory of aid, International trade theory has also been a highly debated topic for many decades. Below are the reviews of most important works on trade as it pertains to developing countries. However, to be in line with the objective of the study the reviews main focus is African countries and research output on Africa.

2.2.1. Theoretical literature review

One of the main contributions for this field is the comparative advantage theory of David Ricardo. Ricardo, in his 1821 book, "On the principles of political economy and taxation", exemplified the benefit of specialization and trade using the example of England and Portugal trading cloth and wine. The model, in its England-Portugal example, assumes that there are two commodities, a single factor and constant returns to scale. The pre-trade commodity price ratio is the function exclusively of the output-factor ratios contained in the production functions. Hence, the composition of trade is exclusively determined by international differences in relative output-factor ratio. Ricardo proposed the principle of comparative advantage, that can be summarized as total output will be higher if people and nations engage in those activities for which their advantages over others are the largest or their disadvantages are the smallest (Ricardo 1821).

The challenge for international trade economists in attempting to test a hypothesis under the Ricardian approach was the single factor assumption which seems unrealistic in a multifactor real world. The Heckscher-Ohlin model relaxes the one factor assumption of the Ricardian model. It assumes two factors and makes international differences in factor endowments the crucial factor in determining comparative advantage. According to the Heckscher-Ohlin theorem, countries' exports use intensively countries' abundant factor. Each country should be able to produce more cheaply goods intensive in the use of a factor when that factor of production is abundant in the country relative to its trading partner.

Regarding trade in developing countries, Watkins and Fowler (2002) argued the scope of developing countries performance of export improvement is limited by the superficially generous trade agreements. According to the authors, the US Africa Growth and Opportunity Act (AGOA) can be one example for this. The agreement allows thirty-nine African countries to access free market for selected number of 'non-sensitive' products. But the countries face strict conditions, for instance the garment and textile export from Africa have to use yarns and fabrics from US. Moreover, opening the domestic market for US investment and trade is

one of the condition African countries have to meet to be eligible to export under Africa Growth and Opportunity Act.

Similarly, other developed countries also use different trade barriers to protect their markets which end up costing developing courtiers. The barriers include non-tariff barriers, anti-dumping actions, tariffs, tariff escalation and product standards. Barriers like tariff which are imposed on import of goods protect domestic producers of similar goods as they increase the domestic market price of the imported good. The North countries impose more than average tariff rates, which sometimes reach 100% or more, on products which incorporate most of the developing countries export such as: fruit and vegetables, beverages, products of food industry, staple food products and tobacco. However, non-tariff barriers appear to be the most significant hindrance for the export growth of African countries. These barriers can be in the form of quotas, rules of origin, seasonal import restrictions and product standards. For instance, the gravity model study of Otsuki et al. (2001) which used data from 15 European and nine African countries concluded that, the product standard measure taken by European Union in order to protect citizens from Aflatoxin resulted a six hundred seventy million US Dollar loss or 64% decline in exports for African exporters of cereals, nuts, and dried fruits, without having any significant health benefit.

Yet, by all measures, the developing countries have shown an extraordinary step towards liberalization in the past two decades. Even some countries like Mali, Mozambique, and Zambia being more open than EU member countries such as Germany, France, and United Kingdom. But, these days the low commodity price and its unstable nature are the strong bottlenecks which prevent developing countries from taking the advantage of trade.

Those liberalization measures taken by developing countries are in part reaction for the disappointment of the import substitution policy those countries followed during the 1950s-1970s. The basic thinking of the reform programmes was to minimize the decision-making role of government on allocation of resources and change the incentive structure to support export through

liberalization of import which is expect to be followed by export promotion rather than import substitution. The main player after minimizing the government role will be the private agent which are expected to favor more stable and high priced manufacturing products using the market operation and export diversification (Shafaeddin 2005).

2.2.2. Empirical literature review

Several studies have been produced concerning the relationship between trade and economic growth such as Ahmed et al. (2011); Onafowora and Owoye (1998). However, having in mind the main research goal of the present dissertation, the literature review on the topic trade-economic growth is going to be focused on developing countries and, in particular, on African countries.

Most studies of growth have a positive conclusion for the question whether open economies experience faster growth than closed economies. According to Yanikkaya (2003), this bias of inclining towards liberalization is a result of a wide range of empirical studies claiming outward-oriented economies have higher growth rates than inward-oriented economies. Moreover, the failure of import-substitution strategy also plays a pivotal role.

In what concerns the analysis of developing countries, Balassa (1985), in a study comprising 43 developing countries for the period extending from 1973 to 1978, suggested that the inter-country economic growth rate difference can be explained by the difference in trade policy among the countries in comparison. According to the study, an outward-oriented policy position appears to have a constructive effect on economic growth. Furthermore, the study indicated that faster economic growth in low-income countries can be achieved by more reliance on manufacturing products and application of modern technology in a suitable policy framework.

In addition, earlier works by Greenaway and Nam (1988); Alam (1991); Salvatore and Hatcher (1991), show that there is a positive relationship between

exports and economic growth. Moreover, these studies sustain that outward oriented countries have generally performed better than inward oriented countries.

Africa has been experiencing slow economic growth due to natural factors like tropical climate, natural resource, and limited access to the sea. Yet, the larger quantitative impact on growth rate of Africa is associated with economic policies such as institutions, government saving and above all openness to international trade. With the implementation of fitting policies, per capita income in Africa could have grown at over 4 percent per a year despite its natural disadvantage. Notwithstanding the pessimism that market-oriented pro-growth reforms would not work in Africa most of the countries openness to international market in Africa has resulted in fast growth. The case is strong for Mauritius and Botswana for decades and Ghana, Guinea-Bissau, Guinea and Uganda more recently. When reforms which allows trade openness are implemented seriously and in a sustained manner they materialized to increase in growth in Africa, as they have in other parts of the world (Sachs and Warner 1997).

In what regards Sub Saharan African (SSA) countries, Onafowora and Owoye (1998), using a vector error correction model, also indicate that an outward looking strategy for promoting export expansion can stimulate economic growth in some African countries. Their results indicate that trade policies, exports, and investment rate shocks have a significant impact on economic growth in 10 of the 12 SSA countries.

According to Ahmed et al. (2011), the 1990s reforms in investment, international trade and foreign direct investment are the outcome of SSA countries unsatisfactory economic performance in the 1980s. The disappointing economic state prompted reforms to be implemented in order to improve economy of the countries. This study uses the autoregressive distributed lag (ARDL) approach and Pedroni panel estimation procedures which allow dealing with heterogeneity. The authors find that both foreign direct investment and exports have a significant impact on economic growth. Moreover, their Granger-type causality tests show

that there is interrelatedness among import, foreign direct investment, export and income. The study recommends more market-oriented policy reforms in SSA countries.

According to Dowrick and Golley (2004), the rate of productivity growth is the main mechanism through which the positive effect of trade is translated to growth. The effect of trade on growth through investment is minor, and tariff rates have an effect on the level of trade affecting the level of growth on the way. However, the effect of trade is dependent on the period, development, and specialization. In the 1960s and 1970s, trade has helped the convergence and allowed developing countries to benefit better than developed countries as they were able to get access to more advanced technology due to trade.

However, as per Dowrick and Golley (2004) in the 1980s and 1990s, trade was less beneficial to the growth of developing countries due to their specialization on the export of primary products as the technology, which allows having rapid productivity growth, e.g., for mining and agriculture, were not available. Hence, in the 1980s and 1990s trade openness contributed more to the developed countries than the developing countries. This might be a result of the nature of technology transfer needed in those two eras. While the transfer of technology in the 1960s and 1970s was knowledge and capital which developing countries manage to adapt in the 1980s and 1990s, the technology transfer needed to have rapid productivity growth changed to what the developing countries lack physical infrastructure and human capital to carry out such as, information and communication technology.

The researchers further noted that, the difference between their study and the study conducted by the World Bank in 2002 is on the definition of more globalized. The World Bank classifies countries as more globalized based on how high the proportion of trade increases. This results China and India to be classified as more globalized despite the fact that their share of trade is below the global average. Excluding these countries, the remaining more globalized developing countries grow slower than the less globalized developing countries during the

1980-2000 period. Indicating the fact that the World banks' 2002 research only stated the obvious that China and India are growing at a rapid scale (Dowrick and Golley 2004).

Harrison (1996) defined seven different openness measures for the purpose of testing the relationship between growth and openness:(i) TR I, index derived from information on commercial policies and exchange rate for 1960-84; (ii) TR H, index derived from nontariff and tariff barriers for 1978-88; (iii) BLACK, black market premium, the deviation between the rate in the black market and the official exchange rate; (iv) TR share, share of trade in GDP; (Bloom et al.) MTIP-movements toward international price, derived from countries tradable relative price using constant and current national account price index; (Bloom et al.) DOLLAR, modified price distortion index from Dollar (1991); and (vii) INDIRECT, indirect bias against agriculture from industrial sector protection and overvaluation of the exchange rate.

They found that the correlation across those seven measures of openness is not always strong. However, the association between those different measures of openness and growth was found to be positive. The nature of the data used for the analysis, whether it is panel or cross-sectional, had an impact on the strength of the association between growth and openness. The study concluded that greater openness leads to high economic growth when openness is significant (Harrison 1996).

Erhieyovwe and Onokero (2013) focused on finding the association between economic development and international trade in Nigeria. The study engaged ordinary least squares (OLS), the error correction method, unit root test and the cointegration test in its empirical analysis. Their results of the Augmented Dickey – Fuller (ADF) test displays that GDP and export have a long run relationship. Moreover, the level of exports is very important and highly significant for international trade. Though it is not as significant as exports, the study also found that the Nigeria economic growth is significantly affected by the exchange rate.

Export promotion or promotion of international trade is found to be a genuine tool for growth of an economy. In line with Ahmed et al. (2011); Erhieyovwe and Onokero (2013) also recommended that the government should promote export of more goods and services. Equally, while promoting export, the government should monitor the country's currency vis-à-vis other countries' currencies.

Mogoe and Mongale (2014) examine the impact of foreign trade on the economic growth of South Africa. The study follows the co-integrated vector auto-regression (CVAR) approach which contains the following steps: Augmented Dickey-Fuller and Phillips-Perron to test for stationarity. All the variables were not stationary at levels but they were stationary at the first difference. The authors have then implemented the Johansen cointegration test and the vector error correction model. The empirical results of the Johansen cointegration test reject the null hypothesis of no cointegration and suggest the presence of a long term economic relationship among all the variables.

In addition, this empirical investigation also reveals that the inflation rate and exports are positively related to GDP whilst imports are negatively related to GDP. These conclusions confirm the finding of Erhieyovwe and Onokero (2013). Moreover, Mogoe and Mongale (2014) recommended that policy makers should improve and strengthen the competiveness of the export sector with the aim of balancing the import sector. Moreover, they suggest that serious attention must be paid to currency evolution since an unstable currency has a negative impact on economic growth.

Brueckner and Lederman (2015) use panel data and novel instrumental-variable estimations to tackle the issues of causality. Using panel data allowed the authors to exploit within-country variations in countries trade openness and GDP per capita, controlling for time-invariant country characteristics that affect both international trade and economic growth. The authors argued that the empirical literature that has investigated the effects of international trade openness on economic growth in cross-sections of countries has been afflicted with the bias of

omitted variables. This bias is generated due to the cross-country differences in history, geography, and ethnic composition.

The researchers used rainfall as one of their instrumental variables to estimate the response of trade openness to within-country variations in GDP per capita. The use of rainfall is justified based on prior studies that show robust effects of rainfall on African countries GDP per capita. The other variable used as an instrument for trade openness in Sub-Saharan African countries is GDP growth rates of OECD countries. This variable was chosen on two bases: first, the supply channel in which higher OECD GDP growth increases OECD countries' exports of goods and services; second, the demand channel in which higher OECD GDP growth leads to an increase in the consumption of goods and services produced by sub-Saharan African countries (Brueckner and Lederman 2015).

The analysis of Brueckner and Lederman (2015) showed that having an open market to international trade promotes the growth of an economy in sub-Saharan Africa. The suggestion of their instrumental variable IV analysis estimation is that, on average, a one percentage point increase in trade openness is accompanied with a 0.5 percentage point short run increase in gross domestic product per capita per a year. While in the long-run, after ten years, the effect is larger, reaching about 0.8 percentage point. More importantly, their results are robust for controlling year effects and other growth correlations related to political institutions and intra-national conflicts. In Table 1 a summary of the literature review on both external aid and trade is presented.

Table 1 –Summary of the literature review

Author/s (Year)	**Method**	**Sample**	**Conclusion**
(Boone 1996)	IV and OLS regression	Panel of 96 countries, for the time period 1971-1990	Aid does not promote economic development. Long-term aid programs having little impact on human development and investment.
Burnside-Dollar (2000)	OLS and 2SLS	56 countries, including 8 low income countries, for the time period 1970-1993	Aid is effective in promoting economic growth when it is accompanied by good economic policy.
(Hansen and Tarp 2001)	OLS , GMM	56 countries, for the time period 1974–1977 to 1990–1993	Aid in all prospect increases the growth rate and the result holds regardless of the policy in the recipient country.
(Gillanders 2011)	Panel vector auto regression model.	Panel of 31 countries over the period 1973-2005.	Aid does work in terms of generating economic growth in early time. But early success of aid is mitigated by later negative responses.
(Ferreira and Simões 2013)	GMM	44 Sub-Saharan African countries and 31 Asian countries, with a time period from 1972 to 2007	Found a negative and significant relationship between aid and growth in each of the regions.
(Knack and Keefer 1995)	OLS	Cross country study. From 1978 to 1989.	Aid affects growth through institutions.
(Young and Sheehan 2014)	OLS and 2SLS	Panel of 116 countries from 1970 to 2010.	Aid flows are not significantly related with growth.
(Adams and Atsu 2014)	Autoregressive Distributed Lag	Ghana, for the period 1970-2011.	Foreign aid has a positive effect in the short run but a negative effect in the long run.
(Tadesse 2011)	Cointegration analysis using OLS	Ethiopia, for the period 1970-2009	Aid has a positive impact on the economy but the aid-policy interaction term has a significant negative impact, which makes the overall effect of aid on economic growth to be negative.
(Balassa 1985)	Cross-section equation using OLS	43 developing countries for the period extending from 1973 to 1978	Outward-oriented policy stance has a favorable effect on economic growth.
(Rajan and Subramanian 2008)	GMM	All developing countries that have received aid during the postwar period. From 1960 to 2000	Found only little robust evidence of a positive (negative) relationship between aid flows and economic growth.
(Onafowora and Owoye 1998),	Vector error correction model	12 sub-Saharan African (SSA) countries.	Outward looking strategy of export expansion can stimulate economic growth in some African countries.
(Ahmed et al. 2011)	ARDL	Sub-Saharan Africa.	Exports and Foreign Direct Investment (FDI) have a significant impact on economic growth.
(Brueckner and Lederman 2015)	Instrumental-variable Approach	Sub-Saharan Africa.	Openness to international trade increases economic growth in sub-Saharan Africa.
(Chong et al. 2009)	Dynamic panel data analysis	For the period 1971-2002	There is a weak evidence that foreign aid is conducive to the improvement of the distribution of income
(Bjørnskov 2010)	IV regression	88 developing countries, for the period 1960-2000	Foreign aid in conjunction with democracy associated with a distribution of national income

			skewed in favor of the richest part of the population.
(Herzer and Nunnenkamp 2012)	Panel cointegration techniques	21 countries, over the period 1970–1995	Aid exerts an inequality increasing effect on income distribution
(Baliamoune-Lutz and McGillivray 2015)	OLS and GMM	Sub-Saharan African, North African and Middle Eastern countries	Higher openness to trade seems to make the marginal effect, other things equal, of gender inequality on income positive
(Bigsten and Durevall 2006)	VAR	Kenya, over the period 1964–2000.	International market integration plays the role of reducing wage inequality in Kenya.
(Batuo and Asongu 2015)	Before and afte approach	26 African countries for the period 1996-2010.	Outcome of trade liberalization is mixed and not clear

Source: Own elaboration.

Chapter three

3. Methodology

3.1. Data description and source

This dissertation uses a cross-country and panel time series data for a total of 48 African countries between the years 1976 and 2015. The study period encompasses the years where data for the variables are available. Thus, due to unavailability of relevant data, years before 1976 and after 2015 are excluded. The main sources of data for this study are the African Union socio economic database[2] and World Bank's World Development Indicators database[3].

The variables used in the study are: GDP per capita, Aid as a percentage of GDP, Trade Openness, Secondary School Enrollment Ratio, Gross Capital Formation, and the sum of Population growth, Technological Progress and Depreciation. The data collected from African Union socio-economic database includes openness for Ethiopia and Lesotho between the years 1980-2012 and Zambia between the year 1976-1993, Secondary school enrolment ratio for Angola between the years 1976-2012, Liberia 1977-1989, Madagascar 1976-1990 and the year 1998, South Africa 1976-1991 and Sudan 1976-1992, and 1999-2000, Gross capital formation between the years 1980-2012 for Angola, Cabo Verde, Ethiopia, Lesotho and Zambia. The remaining data are collected from World Bank's World Development Indicators database.

3.1.1. Samples of the study

The panel regression is performed for the main sample which consists in 48 African countries. The cross-country study includes 3 different samples namely Africa, Sub-Saharan Africa and common market for Eastern and Southern Africa

[2] http://ethiopia.opendataforafrica.org/gwwnvqe/african-union-socio-economicdatabase accessed on May/2017

[3] [3] http://data.worldbank.org/data-catalog/world-development-indicators accessed on May/2017

(COMESA) member countries.[4]

The sample which includes most of the countries other than countries with missing variables is the Africa sample. It includes 48 of the 54 countries in the continent.

The second sample consists of 44 countries in Sub-Saharan Africa. This sample has been the focus of many research works. The countries excluded in the sample are the North African countries Algeria, Egypt, Tunisia, and Morocco.

The third sample comprises of the member countries of Common Market for Eastern and Southern Africa (COMESA). COMESA was formed in 1994 in order to replace the preferential trade area which was established in 1981. It was established to create cooperation among member countries in their Human and natural resource among other objectives. In this sample, 16 of the 19 member countries are included. The study considers COMESA as a separate sample as the cooperation is deigned in order to create a free trade area with a main focus of forming large economic and trading unit.

3.1.2. Definition of Variables

Per capita GDP: gross domestic product divided by the number of midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. GDP is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. As it shows the relative performance of a country, it is a useful indicator to compare countries. An increase in GDP per capita is a signal of growth of the economy and it reflects an increase in productivity. The data for this variable are collected from World Bank Development Indicators and is in constant 2010 U.S. dollars.

Net official development assistance: Based on the World Bank standard definition, official development assistance consists of grants by official agencies of

[4] The list of countries included in the 3 samples is presented in the appendix.

the members of the Development Assistance Committee (DAC), by non-DAC countries, and by multilateral institutions and disbursements of loans made on concessional terms. It is given in order to promote the welfare and economic development in countries and territories in the DAC list of official development assistance (ODA) recipients. Share of Net official development assistance which refers to net of repayments or aid flows from official donors to recipient countries and territories from the total GDP is used in this study. The variable is computed by dividing Aid in current U.S. Dollar by GDP in current U.S. Dollar of the corresponding year and multiplying it by hundred.

$$Aid_{it} = \frac{ODA_{it}}{GDP_{it}} \times 100 \qquad (3.1)$$

Trade openness, is an index which measures the degree of trade liberalization. It is constructed by dividing the sum of exports and imports of a country by the nominal GDP of that country (trade-to-GDP ratio). This measure has benefits as it can be clearly defined and well measured. There are different ways of measuring openness, this method is used on this dissertation for its benefit of having a clear definition and be able to be well measured. Its merits are discussed by Rodrik et al. (2004); Dowrick and Golley (2004).

School: following Mankiw et al. (1992) secondary school enrollment ratio is used as a proxy for human capital. Secondary school enrollment ratio, as define by World Bank, is the ratio of total enrollment, irrespective of age, to the population of the age group that officially corresponds to the level of education shown. Secondary education finalizes the delivery of basic education that began at the primary level, and aims at laying the foundations for human development and lifelong learning, by providing more subject- or skill-oriented teaching using teachers who specialized on the area. The source of these data is World Bank's World Development Indicators (2017).

$(g + \delta)$: sum of technological progress and the rate of depreciation of capital. The value of this variable is assumed to be constant and equal to 0.05. Due to lack of available data the study follows the assumption of Mankiw et al. (1992).

n: is the population growth rate. Using the definition of World Bank, it is the annual growth rate of population for year *t* which is the exponential rate of growth of midyear population from year *t*-1 to *t*, expressed as a percentage.

Gross capital formation: gross domestic investment. As defined by World Bank, "*it consists of expenditures on additions to the fixed assets of the economy plus net changes in the level of inventories. Fixed assets include land improvements i.e. drains, fences, ditches, and so on; machinery, plant, and equipment purchases; and the construction of railways, roads, and the like, including schools, offices, private residential dwellings, hospitals, and industrial and commercial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales, and work in progress. Net acquisitions of valuables are also considered as capital formation*." [5]

3.2. Model specification

In this part of the dissertation, the theoretical background for the specification of the econometric model is presented. The first subsection presents the cross-sectional model. The models included are the Solow growth model and the Mankiw, Romer and Weil (MRW) augmented Solow growth model. After discussing the theoretical background further augmentation of the models for this study purpose is also included. The second subsection presents the theoretical reasoning behind the use of panel data and generalized method of moment.

3.2.1. Cross-sectional model

3.2.1.1. Solow

The growth discussion of the past four decades has, mostly, been focused on the neoclassical model of Solow (1956) and Swan (1956). This model overcomes the problems presented by the Harrod-Domar economic growth model using its simple assumptions such as: homogenous products, exogenous labor-augmenting technical progress, a well-behaved neoclassical production function, full

[5] http://data.worldbank.org/data-catalog/world-development-indicators

employment and exogenous labor force growth.

The growth model of Solow-Swan predicts, in steady state, the level of per capita income will be determined by the available technology and by the rates of population growth, saving and technical progress, all of which are assumed to be exogenous. Due to the difference among countries regarding those variables it yields a prediction which can be tested. For example, how population growth rate and saving rate affect different countries' steady-state levels of per capita income; in this case, ceteris paribus, while population growth and per capita income exhibit a negative relation, high saving is associated with high per capita income (Solow 1956; Swan 1956).

This model is built using the capital accumulation equation and production function. The production function describes how different inputs are combined to produce output. It is constructed on the assumptions of diminishing returns to capital and labour, smooth substitution and constant returns to scale. For the simplification of the model, the inputs can be categorized into two, capital and labour and Y represents output. Following the Cobb-Douglas form of production function output can be defined as,

$$Y = F(K, L) = K^{\alpha}L^{1-\alpha} \qquad (3.2)$$

Where, α is a value between 0 and 1. As the above production function has constant returns to scale meaning doubling input results output to be exactly double e.g., $bY = F(bK, bL)$, for all positive number of *b*. For the purpose of explaining capital or output per worker the above production function can be written in terms of capital per worker, $k = \frac{K}{L}$. And output per worker, $y = \frac{Y}{L}$ When b=1/L,

$$\frac{Y}{L} = F(\frac{K}{L}, 1)$$

$$y = f(k) \qquad (3.3)$$

Where $f(k) = F(k, 1)$

The above equation can be written as

$$y = k^{\alpha} \tag{3.4}$$

The equation which describes how capital accumulates is the second key equation of the Solow model. The capital accumulation equation is given by,

$$\dot{K} = sY - dK \tag{3.5}$$

$$\dot{K} = \frac{dK}{dt} \tag{3.6}$$

In the light of the above equation, "$\dot{K}$", the change in the capital stock is equal to the amount of gross investment, sY, minus the amount of depreciation that occurs during the production process, dK. The above question left-hand term dK is a continuous time version of $K_{t+1} - K_t$, which means a period change in the stock of capital. And the 'dot' notation on the variable represents the derivative with respect to time.

The capital accumulation equation can be written in the form of capital per worker in order to study the evolution of output per worker in the economy.

$k = \frac{K}{L}$ taking the natural log of this will give us

$$\ln k = \ln K - \ln L$$

$$\frac{d\ln k}{dt} = \frac{d\ln K}{dt} - \frac{d\ln L}{dt} \tag{3.7}$$

The derivative of the logarithm of the variable with respect to time gives the growth rate:

$$\frac{\dot{k}}{k} = \frac{\dot{K}}{K} - \frac{\dot{L}}{L}$$

The growth in capital stock can be driven from, the capital accumulation equation. $\dot{K} = sY - dK$,

$$\frac{\dot{K}}{K} = s\frac{Y}{K} - d \qquad (3.8)$$

Substituting this equation into equation (3.7),

$$\frac{\dot{k}}{k} = s\frac{Y}{K} - d - n \qquad (3.9)$$

Where "n" represents the labor force growth $(\frac{\dot{L}}{L})$

Dividing the numerator and denominator of the left-hand side of the equation by L and multiplying both sides of the equation by k,

$$\dot{k} = sy - (n + \delta)k \qquad (3.10)$$

The steady state quantity of capital per worker is determined when $\dot{k} = 0$ is met. Hence,

$$\dot{k} = sk^{\alpha} - (n + \delta)k$$

$$sk^{\alpha} = (n + \delta)k$$

$$\frac{sk^{\alpha}}{(n + \delta)} = k$$

The steady state quantity of capital per worker will be:

$$k^{*} = \left(\frac{s}{(n + \delta)}\right)^{\frac{1}{1-\alpha}} \qquad (3.11)$$

Substituting this equation into the production function steady-state quantity of output per worker will be:

$$y^{*} = \left(\frac{s}{(n + \delta)}\right)^{\frac{\alpha}{1-\alpha}} \qquad (3.12)$$

From the above Solow model, we can infer that countries with high population growth will have lower growth, while high saving to investment ratio

results in higher growth. But, the above simple Solow model ignores the existence and role of technology. In order to create sustained per capita income growth in the above model, technological progress is introduced. This can be done by inserting a variable representing technology, *A*, to the production function

$$Y = K^{\alpha}(AL)^{1-\alpha} \qquad (3.13)$$

Where α is a value between 0 and 1, Y is output and K, L and A represents capital, labour, and technology, respectively. In the above equation the variable denoting technology, A, is "labour-augmenting". An increase in A overtime indicates the occurrence of technological progress. Thus, a higher level of technology results in a higher productivity of a unit of labour. The model assumes n to be the level by which labour grows and g is the level by which technology grows. Since the model assumes labour and technology are exogenous;

$$A_t = \frac{\dot{A}}{A} = g \Leftrightarrow A = A_0 e^{gt}$$

$$L_t = L_0 e^{nt} \qquad (3.14)$$

$(n + g)$ is therefore, the rate by which the number of effective unit of labour, $A_t L_t$, grows and δ is the rate by which the stock of capital depreciates over time. The Solow model with technology also assumes that constant fraction of output is invested and defines k as stock of capital per effective unit of labour, $k = \frac{K}{AL}$, and y as the level of output per effective unit of labor, $y = \frac{Y}{AL}$.

$$\dot{k} = sy - (n + g + \delta)k \qquad (3.15)$$

The steady state level of $\dot{k}$ converges to;

$$k^{*} = \left(\frac{s}{(n + g + \delta)}\right)^{\frac{1}{1-\alpha}}$$

Substituting the above equation into the production function and taking log will result;

$$\ln\left(\frac{Y_t}{L_t}\right) = \ln A_0 + g_t + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n + g + \delta) \qquad (3.16)$$

Assuming factors are paid their marginal product, because capital's share in income is roughly one-third, the model implies an elasticity of income per capita with respect to the saving rate of approximately 0.5 and an elasticity with respect to $(n + g + \delta)$ of approximately -0.5.

Mankiw et al. (1992) tried to answer if indeed the prediction of the Solow model about the determinants of growth is supported by the empirical data. They analyzed if real income is lower in a country where there is high value of $(n + g + \delta)$ and high in a country where there is high saving rate.

They assumed g – on which knowledge advancement is primarily reflected, which is not country-specific, to be constant. And, as they do not expect depreciation rate to vary greatly across countries, and due to the lack of availability of data that allows to estimate country-specific depreciation rate, δ is also assumed to be constant in the model. They assumed that,

$A_0 = a + \varepsilon$ where a is some constant number and ε is country specific shock. Thus, the log income per capita at time 0 is given by

$$\ln\left(\frac{Y_t}{L_t}\right) = a + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n + g + \delta) + \varepsilon \qquad (3.17)$$

3.2.1.2. Mankiw, Romer, and Weil

Mankiw et al. (1992) estimated the above equation with OLS assuming n and s are independent of ε. They estimated the above equation in two cases; imposing the constraint that the coefficients on ln $(n + g + \delta)$ and ln(s) have reverse signs and equal magnitudes, and otherwise. The paper assumed that $g + \delta$ is 0.05. The conclusion of the study supported the Solow model, as the coefficient of population growth and saving has the predicted sign, the large portion the discrepancy in per capita income among countries is accounted by difference in population growth and saving, and the restriction that the coefficients on ln

$(n + g + \delta)$ and ln(s) have reverse sign and equal magnitude is not rejected.

However, they also suggested that the Solow model is not completely successful. The estimated impact of labour force growth and saving are larger than the one predicted by the Solow model. And as human capital is positively correlated with both population growth and saving, if the model does not account for human capital the quantitative implications of different saving and population growth rates are biased upward. Thus, they incorporated human capital in the Solow growth model.

$$Y_t = K_t^{\alpha} H_t^{\beta} (A_t L_t)^{1-\alpha} \qquad (3.18)$$

Where H denotes the stock of human capital, and the other variables in the equation are as defined before. Let S_h and S_k be the portion of income invested in human capital and the portion of income invested in physical capita, respectively.

$$\dot{k} = S_k y_t - (n + g + \delta)k_t \qquad (3.19a)$$

$$\dot{h} = S_h y_t - (n + g + \delta)h_t \qquad (3.19b)$$

Where $k = \frac{K}{AL}$, $y = \frac{Y}{AL}$ and $h = \frac{H}{AL}$ are output per effective unit of labour. Since the model assumes decreasing returns to scale, the sum of α and β is less than one. Hence, the steady state level of capital is given as,

$$k^* = \left(\frac{S_k^{1-\beta} S_h^{\beta}}{(n + g + \delta)}\right)^{\frac{1}{1-\alpha-\beta}} \qquad (3.20a)$$

$$h^* = \left(\frac{S_k^{\alpha} S_h^{1-\alpha}}{(n + g + \delta)}\right)^{\frac{1}{1-\alpha-\beta}} \qquad (3.20b)$$

Substituting the above equation 3.20a and3.20b on the production function and taking the natural log results,

$$\ln\left(\frac{Y_t}{L_t}\right) = A_0 + g_t - \frac{\alpha+\beta}{1-\alpha-\beta}\ln(n+g+\delta) + \frac{\alpha}{1-\alpha-\beta}\ln(S_k) + \frac{\beta}{1-\alpha-\beta}\ln(S_h) \quad (3.21)$$

Based on the assumption by MRW that the level of technology is not correlated with variables in the right-hand of the equation; it can be written as $A + g_t = a + \varepsilon$ hence,

$$\ln\left(\frac{Y_t}{L_t}\right) = a + \frac{\alpha}{1-\alpha}\ln(S_k) + \frac{\beta}{1-\alpha}\ln(S_h) - \frac{\alpha}{1-\alpha}\ln(n+g+\delta) + \varepsilon_t \quad (3.22)$$

3.2.1.3. Adding Trade and Aid

This study considers that, in addition to human capital, Aid and Trade plays an important role in explaining growth in African countries. Additionally, incorporating these variables helps to explain why the countries in the continent struggle to achieve a sustained growth intercontinentally and why they experience different intra-continental variation in growth. When the MRW Cobb-Douglas production function is extended, it will have the following form:

$$Y_{it} = {K_{it}}^{\alpha} H_{it}^{\beta} O_{it}^{\theta} T_{it}^{\gamma} (A_{it}L_{it})^{1-\alpha-\beta-\theta-\gamma} \quad (3.23)$$

Where *i* and *t* denote, country and time, respectively. *Y* is real output, *H* the stock of human capital, *K* the stock of physical capital, *O* the share of official development assistance, henceforth Aid, as a percentage of GDP, *T* share of trade from total GDP, *L* the labour input, and *A* the labour-augmenting level of technology.

When quantity per effective unit of labor is $k = \frac{K}{AL}$ for physical capita, $y = \frac{Y}{AL}$ for Output, $h = \frac{H}{AL}$ for human capita, $o = \frac{O}{AL}$ for aid, and $t = \frac{T}{AL}$ for trade. The output function can be written as:

$$y_{it} = {k_{it}}^{\alpha} h_{it}^{\beta} o_{it}^{\theta} t_{it}^{\gamma} \quad (3.24)$$

Like the Solow model, this extended version of the model assumes *n* to be the level by which labour grows and *g* is the level by which technology grows. Since the model assumes labour and technology are exogenous;

$$A_{it} = \frac{\dot{A}}{A} = g \Leftrightarrow A_t = A_0 e^{gt}$$

$$L_{it} = L_{i0} e^{n_i t} \tag{3.25}$$

As *n* and *g* are assumed to be constant across country the accumulation of physical capital, human capital, aid and trade are modeled as

$$\dot{k}_{\iota,t} = S_k y_{i,t} - (n + g + \delta) k_{i,t} \tag{3.26a}$$

$$\dot{h}_{\iota,t} = S_h y_{i,t} - (n + g + \delta) h_{i,t} \tag{3.26b}$$

$$\dot{o}_{\iota,t} = S_o y_{i,t} - (n + g + \delta) o_{i,t} \tag{3.26c}$$

$$\dot{t}_{\iota,t} = S_h y_{i,t} - (n + g + \delta) t_{i,t} \tag{3.26d}$$

Where $k = \frac{K}{AL}$, $y = \frac{Y}{AL}$, $h = \frac{H}{AL}$, $o = \frac{O}{AL}$, and $t = \frac{T}{AL}$, are output per effective unit of labour. In order to function at steady-state, decreasing returns to scale are also assumed. Thus, $\alpha + \beta + \theta + \gamma < 1$. Hence, the steady state level of Physical capital, Human capital Aid and Trade is given as,

$$k^*_i = \left(\frac{{S_k}^{1-\beta-\theta-\gamma} {S_h}^{\beta} {S_o}^{\theta} {S_t}^{\gamma}}{(n + g + \delta)} \right)^{\frac{1}{1-\alpha-\beta-\theta-\gamma}} \tag{3.27a}$$

$$h^*_i = \left(\frac{{S_k}^{\alpha} {S_h}^{1-\alpha-\theta-\gamma} {S_o}^{\theta} {S_t}^{\gamma}}{(n + g + \delta)} \right)^{\frac{1}{1-\alpha-\beta-\theta-\gamma}} \tag{3.27b}$$

$$o^*_i = \left(\frac{{S_k}^{\alpha} {S_h}^{\beta} {S_o}^{1-\alpha-\beta-\gamma} {S_t}^{\gamma}}{(n + g + \delta)} \right)^{\frac{1}{1-\alpha-\beta-\theta-\gamma}} \tag{3.27c}$$

$$t^*_i = \left(\frac{S_k{}^{\alpha} S_h{}^{\beta} S_o{}^{\theta} S_t{}^{1-\alpha-\beta-\theta}}{(n+g+\delta)}\right)^{\frac{1}{1-\alpha-\beta-\theta-\gamma}} \qquad (3.27d)$$

Substituting 3.27a-d into the production function equation and taking the natural log, yields

$$\ln\left(\frac{Y_t}{L_t}\right) = \ln A_0 + g_t + \frac{\alpha}{1-(\alpha+\beta+\theta+\gamma)}\ln(S_k) + \frac{\beta}{1-(\alpha+\beta+\theta+\gamma)}\ln(S_h) + \frac{\theta}{1-(\alpha+\beta+\theta+\gamma)}\ln(S_o) + \frac{\gamma}{1-(\alpha+\beta+\theta+\gamma)}\ln(S_t) - \frac{\alpha+\beta+\theta+\gamma}{1-(\alpha+\beta+\theta+\gamma)}\ln(n+g+\delta)$$

Let $\psi \equiv 1-(\alpha+\beta+\theta+\gamma)$, then the function can be specified as

$$\ln\left(\frac{Y_t}{L_t}\right) = \ln A_0 + g_t + \frac{\alpha}{\psi}\ln(S_k) + \frac{\beta}{\psi}\ln(S_h) + \frac{\theta}{\psi}\ln(S_o) + \frac{\gamma}{\psi}\ln(S_t) - \frac{\alpha+\beta+\theta+\gamma}{\psi}\ln(n+g+\delta) \qquad (3.28)$$

Following the assumption of MRW that the level of technology is not correlated with variables in the right-hand of the equation, it can be written as $A + g_t = a + \varepsilon$ and let S_o and S_t be the portion of aid and trade from the per capita income, respectively. Therefore,

$$\ln\left(\frac{Y_t}{L_t}\right) = a + \frac{\alpha}{\psi}\ln(S_k) + \frac{\beta}{\psi}\ln(S_h) + \frac{\theta}{\psi}\ln(S_o) + \frac{\gamma}{\psi}\ln(S_t) - \frac{\alpha+\beta+\theta+\gamma}{\psi}\ln(n+g+\delta) + \varepsilon_i \qquad (3.29)$$

Where,

- $\ln\left(\frac{Y_t}{L_t}\right)$ is the output per capita at year *t*. In this study year *t* is 2015. and output per capita is measured by per capita GDP.
- $\ln(S_k)$ is physical capital. Physical capital is measured by Gross capital formation.

- $\ln(S_h)$ is human capital. Like MRW secondary school enrollment ratio is used as a proxy for human capital. As explained in MRW it is not a precise method of measuring human capital. However, the nature of it being easily measurable, availability of data and its proven approximation to measuring human capital makes it a good choice for this study as well.
- $\ln(S_o)$ is the proportion of Aid from total output. This is an additional variable in the MRW model. In this study S_o denotes Net official development assistance or Aid as a percentage of GDP.
- $\ln(S_t)$ is the proportion of Trade from total output. The study uses a measurement of openness, the sum of export plus import divided by GDP, to proxy Trade. This is also another additional variable used to further augment the Solow model.
- $\ln(n + g + \delta)$ is the sum of population growth technological progress and depreciation. As there are no country specific data available even after the MRW research, this study also considers the value of $g + \delta$ to be 5 percent. Hence, the variable is defined as population growth plus 0.05

3.2.2. Panel Model specification

After the use of a dynamic panel data model by Balestra and Nerlove (1966), pioneers in the area, this methodology gained immense attention among economists working on time series data. The inclusion of a lagged dependent variable among the regressors is the main characteristic of the model. The author proposed a dynamic panel data analysis which allows including the lagged value of the dependent variable. The model is chosen as the growth at a time "*t*" is affected by growth at a time "*t*-1". Dynamic panel data analysis is chosen in addition to cross-country analysis as the former has an advantage of allowing use of both time-series and the cross-sectional variation in the data.

Taking the general autoregressive model of order p in $y_{i,t}$ with

$y_{i,t-1}, \ldots, y_{i,t-p}$ and $x_{i,t}$ as a regressors, the model is

$$y_{i,t} = \gamma_1 y_{i,t-1} + \cdots \gamma_p y_{i,t-p} + x'_{i,t}\beta + \alpha_i + \varepsilon_{i,t} \quad t=p+1, \ldots, T \qquad (3.30)$$

Where α_i is a fixed effect, $x'_{i,t}$ is a vector of time variant explanatory variables, and ε_i is the error term. The objective is to generate a consistent estimate of γ and β when α_i is a fixed effect. However, α_i being a random effect doesn't affect the consistency of the estimators (Colin and Trivedi 2009).

In the above model, according to Colin and Trivedi (2009) there are at least three different reasons for correlation in *y* over time. One is the true state dependency, directly through *y* in the preceding period. The other is observed heterogeneity, directly through observable *x* and unobserved heterogeneity, indirectly through the time-invariant effect α_i.

According to Nickell (1981) applying OLS on equation (3.30) would result on a "dynamic panel bias". This bias is caused by the correlation between $y_{i,t-1}$ and the error term. One way of transforming this equation is by taking first differences. Taking the first difference will also swipe out the individual effect α_i.

Thus, the equation can be rewritten as;

$$y_{i,t} - y_{i,t-1} = \gamma(y_{i,t-1} - y_{i,t-2}) + \beta(x'_{i,t} - x'_{i,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1})$$

Or,

$$\Delta y_{i,t} = \gamma_0 \Delta y_{i,t-1} + \ldots + \gamma_p \Delta y_{i,t-p} + \Delta x'_{i,t}\beta + \Delta\varepsilon_{i,t} \qquad (3.31)$$

In equation (3.31) the problem of fixed effect is gone but estimating the above equation by OLS will result in inconsistent parameter estimates as the regressor $\Delta y_{i,t-1}$ is correlated with the error term $\Delta\varepsilon_{i,t}$, even if the error term is not serially correlated. For serially uncorrelated error term, the fixed effect model error $\Delta\varepsilon_{i,t} = \varepsilon_{i,t} - \varepsilon_{i,t-1}$ is correlated with $\Delta y_{i,t-1} = (y_{i,t-1} - y_{i,t-2})$ as the value of $y_{i,t-1}$ depends on $\varepsilon_{i,t-1}$. Because $\Delta\varepsilon_{i,t}$ is uncorrelated with $\Delta y_{i,t-c}$ for $c \geq 2$ it is possible to use the lagged variables as an instrument. An instrument variable is

assumed to be correlated with the explanatory variables and uncorrelated with the error term (Colin and Trivedi 2009).

According to Arellano and Bond (1991), $\Delta Y_{i,t-1}$ or $Y_{i,t-1} - Y_{i,t-2}$ can take not only $Y_{i,t-2} - Y_{i,t-3}$ as instrument but also any variable such that $Y_{i,t-2-j}$ where j= 0, 1,… satisfies the following condition:

$$E(Y_{i,t-2-j}\ (Y_{i,t-1} - Y_{i,t-2})) \neq 0$$

$$E(Y_{i,t-2-j}\ (\varepsilon_{i,t} - \varepsilon_{i,t-1})) = 0 \qquad (3.32)$$

Hence, all the lagged variables are legitimate instruments for $(Y_{i,t-1} - Y_{i,t-2})$.

In addition, according to Caselli et al. (1996) the OLS estimation which follows the Solow and the augmented Solow model by MRW is inconsistent due to the inclusion of the lagged dependent variable. And panel data can be a solution to some of the problems associated with cross-sectional data. Among the problems which come from estimation by OLS are endogeneity, omitted variable bias and inconsistency correlated with country specific effect. Using the GMM can help to remedy those problems.

In order to address the missing value problem this study uses a 5 years average between 1976 and 2015. In this study output is measured by GDP per capita at constant U.S. Dollar 2010. Saving or investment is measured by gross capital formation average for 5 years. Population growth and the human capital proxy secondary school enrolment ratio are also averages for 5 years. In addition, the MRW assumption of the sum technological progress and depreciation equals to 0.05 holds for this study as well. Following the above logic, the model in this study is defined as below

$$\begin{aligned} \ln Y_{i,t} - \ln Y_{i,t-1} &= \gamma_0 + \gamma_1 \ln Y_{i,t-1} + \gamma_2 \ln(n_{i,t} + g + \delta) + \gamma_3 \ln S_{k_{i,t}} + \gamma_4 \ln S_{i,h_{i,t}} \\ &+ \gamma_5 \ln Aid_{i,t} + \gamma_6 \ln Trade_{i,t} + \varepsilon_{i,t} \qquad (3.33) \end{aligned}$$

Where, $Y_{i,t}$ is per capita GDP at time t, $Y_{i,t-1}$ per capita GDP of t-1, S_k is Gross capital formation, "Aid" is the share of official development assistant in GDP, "Trade" is openness (the sum of exports and imports divided by GDP), "$\left(n_{i,t} + g + \delta \right)$" is the sum of population growth, technological progress and depreciation, $S_{i,h}$ corresponds to the secondary school enrolment ratio, "γ_0" are constant and parameter respectively and "ε" is the error term with zero mean and constant variance. The parameters γ_1 , $\gamma_{2.}$ … γ_7 measure responsiveness (elasticity) of per capita real gross domestic product to the change in the respective variables.

As discussed by Hansen and Tarp (2001) the issue of endogeneity when dealing with Aid and growth relationship needs to be addressed. The empirically established inverse relationship, between the recipient country's per capita income and the level of Aid, makes it difficult to assume aid as a lump-sum transfer independent from the level of the recipient country's income. For aid to be an exogenous variable the following condition must satisfy

$$E(\ln Aid_{i,t}\ \varepsilon_{i,s}) = 0 \text{ for all s and t} \qquad (3.34)$$

However, if the level of Aid is dependent on the level of income, assuming aid as an exogenous increase in capital in this analysis will lead to an incorrect specification. The other possibility is considering aid as endogenous variable which satisfies the conditions below

$$E(\ln Aid_{i,t}\ \varepsilon_{i,s}) \neq 0 \text{ for } s \leq t \qquad (3.35)$$

$$E(\ln Aid_{i,t}\ \varepsilon_{i,s}) = 0 \quad \text{for all } s > t \qquad (3.36)$$

According to the above condition endogenous variables allow for correlation between $\ln Aid_{i,t}$ and the $\varepsilon_{i,t}$ at time t. Yet, assuming aid responds to all current shocks will also lead to incorrect specification. A way of dealing with this endogeneity is assuming aid is a predetermined variable. Hence, aid satisfies the following conditions

$$E(\ln Aid_{i,t}\ \varepsilon_{i,s}) \neq 0 \text{ for } s < t \qquad (3.37)$$

$$E(\ln Aid_{i,t}\ \varepsilon_{i,s}) = 0 \quad \text{for all } s \geq t \qquad (3.38)$$

Thus, given the definition and the nature of the flow of Aid, it will only be correct to assume Aid is not a strictly exogenous variable. Hence, in the present study Aid is considered as a predetermined variable.

3.3. Method of analysis

The cross-country data are analyzed using the OLS regression. In order to regress the variables using OLS the assumption of MRW that gross capital formation and population growth are independent of the country-specific factor which shifts the production function is followed. In other words, *n* and Gross capital formation (GCF) are independent of the error term. The OLS regression presents the Solow model and its replication using the study sample period and countries. In addition, the MRW augmented Solow model followed by the further augmented model developed in this study are estimated.

Finally, the model developed in the panel section is estimated using the GMM estimation. GMM uses lagged levels of the regressors as instruments in the difference equation, and lagged differences of the regressors as instruments in the levels equation. In addition to the above-mentioned benefit, this enables to exploit the orthogonal condition between the lagged dependent variables and the error term. Moreover, GMM has been favored by many recent contributors working on panel data in developing countries (e.g., Asiedu et al. (2009); Walsh and Yu (2010); Arestis and Caner (2010)). Hence, the dynamic panel data models are analyzed using a GMM estimator to estimate the auto-regressive model.

There are two GMM estimators. The difference GMM estimator developed by Arellano and Bond (1991) and the system GMM estimator developed by Arellano and Bover (1995); Blundell and Bond (1998). This study presents results of a twostep estimation of difference GMM and system GMM estimator. The use of System GMM allows keeping the cross-country variation from being removed, and in a small sample case it assists moderating the potential biases of the difference

GMM estimator.

Chapter Four

4. Data analysis

This section presents detailed descriptive statistics of the macroeconomic data collected from World Bank Development indicators and African union socio economic database. The presented figures have two natures: one is computing the mean value of the variables over the time period and the other is computing the mean value across countries.

4.1. Descriptive analysis

The statistical data collected from World Bank Development indicators is presented using tables and different figures. The analysis is made using a time average and country average independently. Mainly the trend of population growth and economic growth, Gross capital formation and School, growth rate of per capita GDP and per capita GDP, aid and per capita GDP, and trade and per capita GDP are discussed in the mentioned order. The exploration covers the year 1976 to 2015 for 48 African countries. The remaining countries are dropped from the analysis due to absence of data for main variables like Aid and Trade.

Table 2 – Descriptive statistics

Variable	Africa		SSA		COMESA	
	48 Countries		44 Countries		16 Countries	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
lnPGDP2015	7.229	1.106	7.141	1.112	7.070	1.163
lnngd	-2.584	0.080	-2.577	0.078	-2.589	0.096
lnGCF	-1.560	0.355	-1.586	0.357	-1.676	0.225
lnSchool	3.254	0.607	3.187	0.586	3.370	0.606
lnAid	1.976	1.051	2.110	0.957	2.102	0.687
lnTrade	4.193	0.451	4.197	0.468	4.020	0.487

Source: Own elaboration.

The above table presents descriptive statistics of Log of the variables using a country average of the year 1976-2015. As the table results are a country average the number of observation is equal with the number of countries. The deviation from the mean in the three cross-sectional samples as well as the panel sample below does not show a large difference except for lnAid.

Variable	Number of Observations	Mean	Std. Dev.	Min	Max
Country				1	48
Year				1	8
Gross Capital Formation	375	22.57	14.08	3.063	174.4
Population Growth	384	2.568	0.989	-3.987	6.81
School enrollment	343	32.09	23.16	32.05	113.2
Aid(%GDP)	373	10.61	10.63	0.053	87.78
Trade(%GDP)	373	73.58	43.63	13.38	436.6

Source: Own elaboration.

The fourth-row presents Gross capital formation. A total of 375 observations for 1976-2015 average is used. The minimum and maximum of Gross capital formation were registered in 1996-2000 time period by Sierra Leone and Equatorial Guinea. The next row gives information about the growth of population. The minimum population growth registered between the year 1991-1995 was in Rwanda. The -3.87 population growth is a mark left by the Rwandan armed force and Rwandan patriotic front civil war between 1990-1994[6] which resulted in massive migration and death. The highest growth of population was also registered in Rwanda in the next five years after the civil war.

Since the thesis has an objective of comparing the impact of aid and trade the data was treated in a way that the number of observations can be equal. One of the way was to search for alternative credential data sources to have a balanced data. When data for the variable with missing value in the World bank data base is

[6] https://en.wikipedia.org/wiki/Rwandan_Civil_War, accessed on June/2017

not found, the available data in the corresponding year is treated as missing value. Hence, the study has a balanced observation of 373 for both trade and aid.

On average Gross capital formation is 22.57 % for all the countries under study. The average growth of population for the 48 African countries between the study period is 2.57. The school enrolment ratio, share of aid from GDP and share of trade from GDP are 32.1%, 10.6%, and 73.6%, respectively.

4.1.1. Population and economic growth

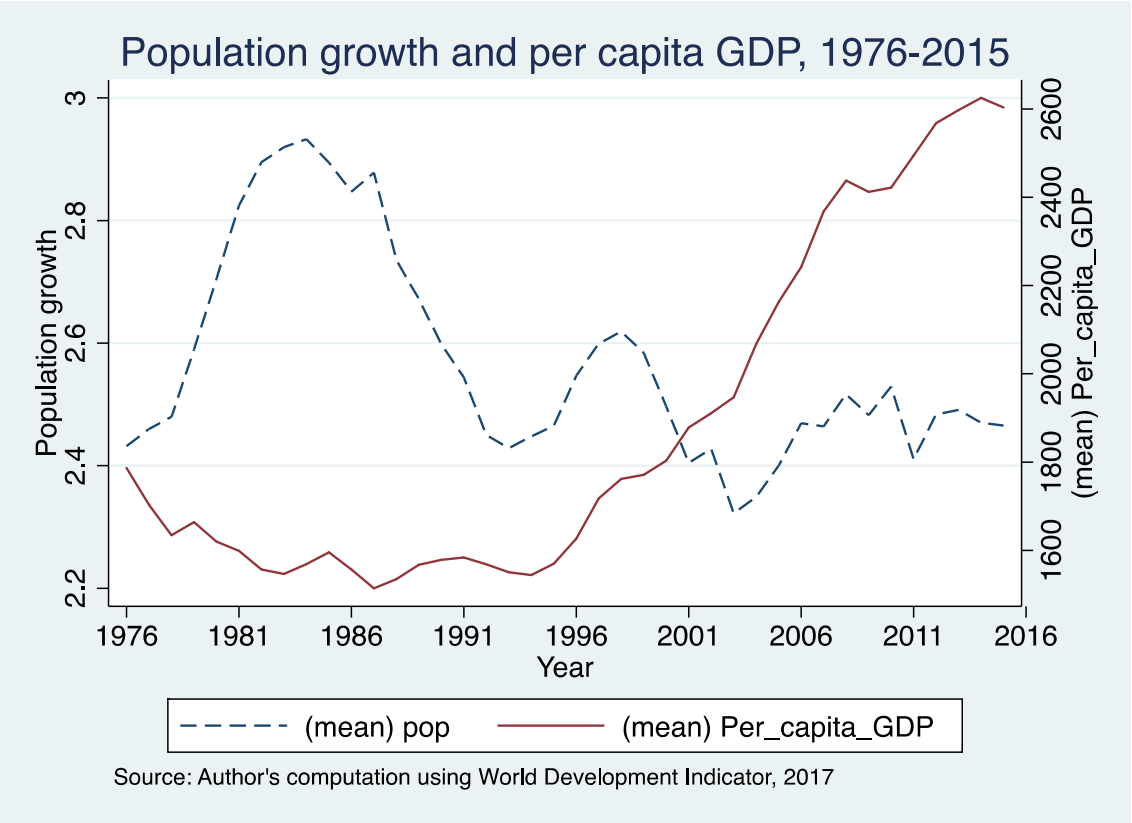
The topic of population growth and its impact on economic growth is attached to the contribution of Malthus in the 1790s. According to Malthus, food supplies tend to grow arithmetically while population tend to grow geometrically. Hence, population growth decreases the output per capita as output growth cannot match with the population growth. Therefore, for population growth to match with the output growth there are two possible checks. One is preventive check which holds the birth rate lower e.g. through birth control and avoiding early marriage. And the other is positive check which plays a role of increasing the death rate, e.g., war, hunger, and disease (Malthus 1798).

Several researches have been conducted to investigate whether there is a causal link between economic growth and population growth. Yet, diverse conclusions have been reached by those researchers. Akintunde et al. (2013) studied the effect of population growth on economic growth in Sub-Saharan Africa. In their study over the period 1970-2005, which used a five year average, the data was analyzed using dynamic panel data and pooled OLS estimation. They suggested that, in order to have a sustainable economic development, Sub-Saharan Africa countries need to address the population growth. This is because the result of the estimation shows a negative relationship between fertility rate and economic growth in the 35 countries under study.

The figure below shows the time series change in economic growth proxy of per capita GDP and the growth rate of population for the 48 African countries.

Given the fact that many other developing countries in the world has undergone the transition in demography, i.e., from high mortality and high fertility to low mortality and low fertility, the delay in this transition in Africa has been considered as a lagging factor (Bloom et al. 1998).

Figure 1 – Population growth and per capita GDP



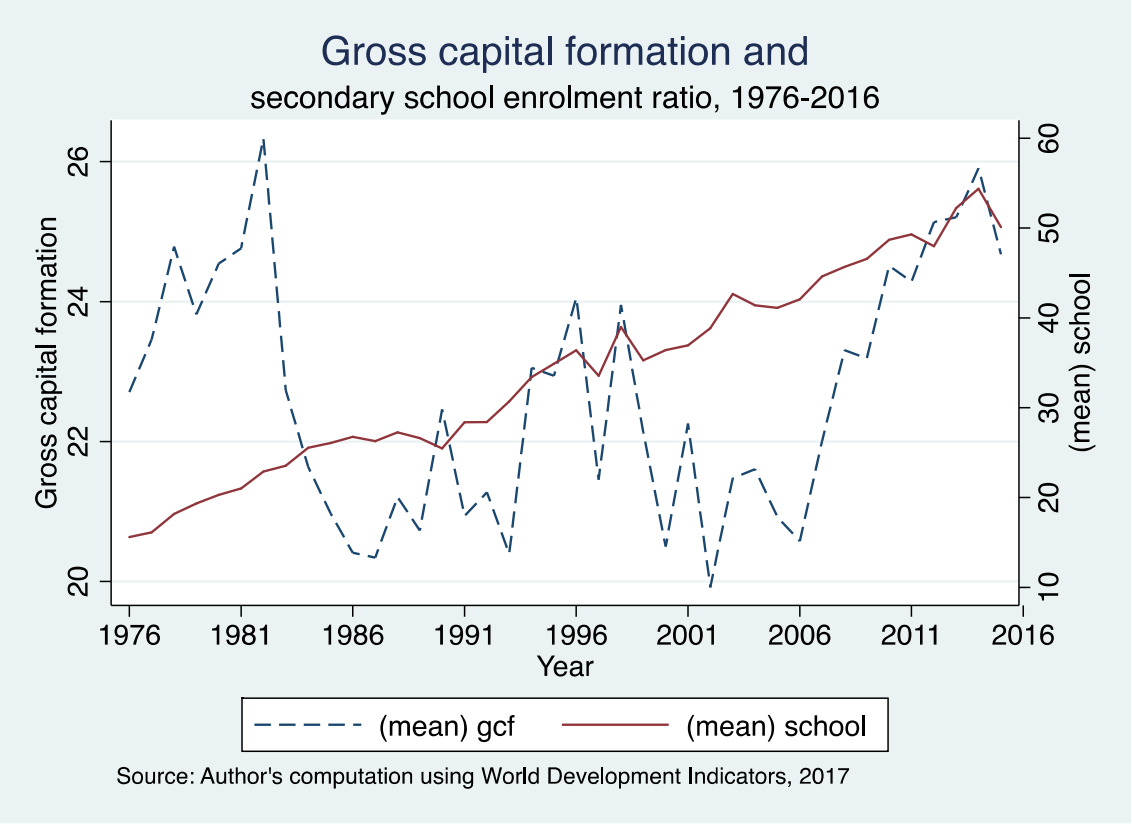
The above figure appears to show some correlation between population growth and per capita GDP. The growth of population increases from the start of the sample year till mid-1980s. This increase in population growth is accompanied with a decline in per capita GDP. However, the growth of population declines from over three percent in 1986 to over 2.4 percent in 2015. Throughout the sample period high population growth is matched by low economic growth. Moreover, after a sharp decline up to 1993, population growth shows an increase for about five years. And the potential minimum of the population growth was registered in 2003 after which it shows a slight increase and more volatility. All in all, promising

progress has been observed in the sample period of this study.

However, despite this progress a rapid population growth is still expected in the future. Africa is anticipated to be the only major area with a substantial growth of population, more than half of the population growth in the globe, after 2050. The share of Africa's population from the global population is projected to grow 25 percent in 2050 and grow even further to 39 percent in 2100. More importantly, Africa has the youngest age distribution. The population under age 15 and between age 15 and 24 accounts for 41 percent and 19 percent of the total population in 2015, respectively (DESA 2015).

4.1.2. Gross capital formation and Human capital

Figure 2 – Gross capital formation and Secondary school enrollment ratio



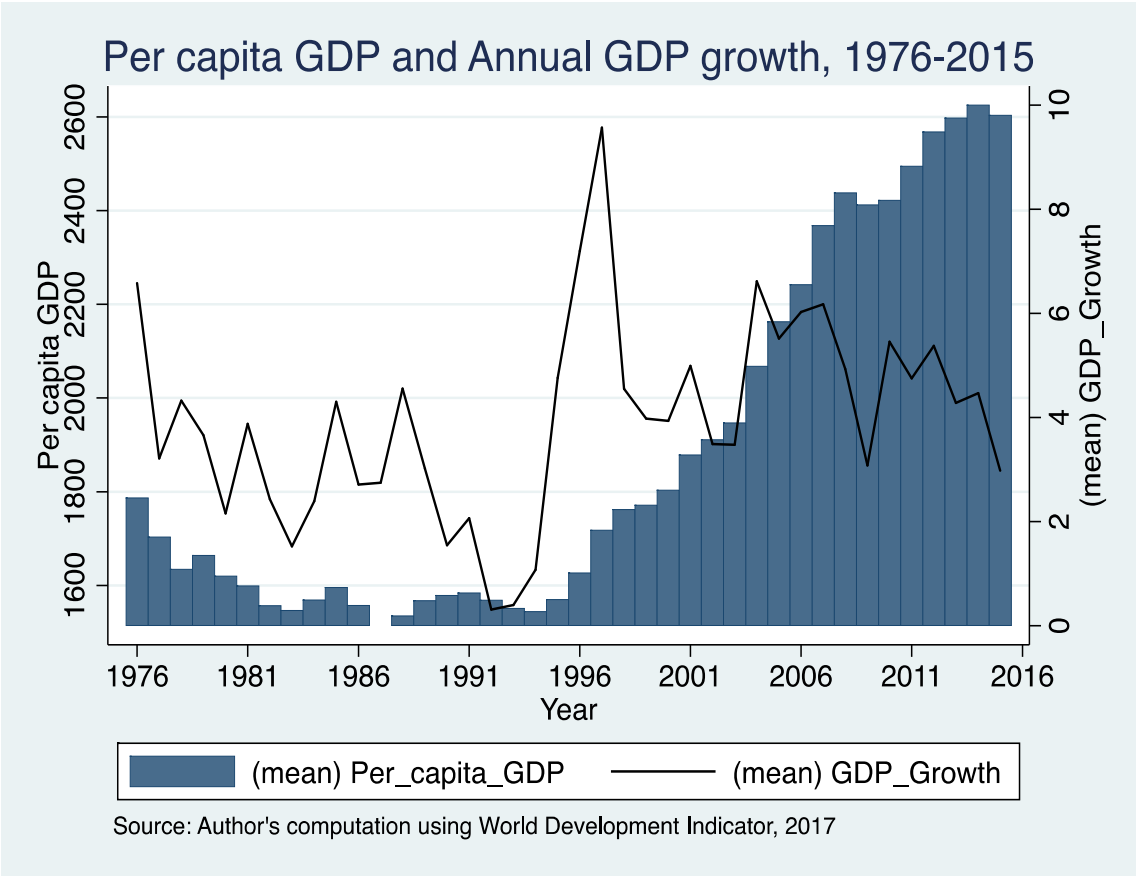
The above figure displays the time trend in human capital, measured by secondary school enrollment ratio, and saving or investment, measure by gross

capital formation. The values are averaged for all countries in the sample in each year. Secondary school enrollment ratio shows an increase trend starting from the beginning of the sample period. Gross capital formation shows a great volatility in most of the years under study, but the percentage of gross capital formation from GDP has shown an increasing trend after 2006.

4.1.3. GDP growth and per capita GDP

The growth of an economy has a great contribution towards the standard of living in a country. Strong and steady economic growth is essential for poverty reduction. This was substantiated by the fast growing East Asian countries where growth allows the area to uplift quarter a billion people above the poverty line (Gill et al. 2007).

Figure 3 – Per capita GDP and GDP growth, 1976-2015 average



The figure above shows the mean values of African countries growth rate of GDP per capita over 1976-2015. Growth rate of GDP per capita is an annual percentage growth rate of GDP per capita, gross domestic product divided by midyear population, based on constant 2010 U.S. dollars. The calculation of World Bank makes no deduction for degradation of natural resources and depletion or for depreciation of fabricated assets.

It is quite clear that the mean value of per capita GDP growth of the continent has shown a very volatile change throughout the sample period of 1976-2015. The ups and downs are more likely to be associated with international commodity price, e.g., between 1999 and 2008 the price of oil rose from less than $20 a barrel to more than $145. The growth of African countries economy is showing a decline in recent years. However, the per capita GDP is moderately increasing.

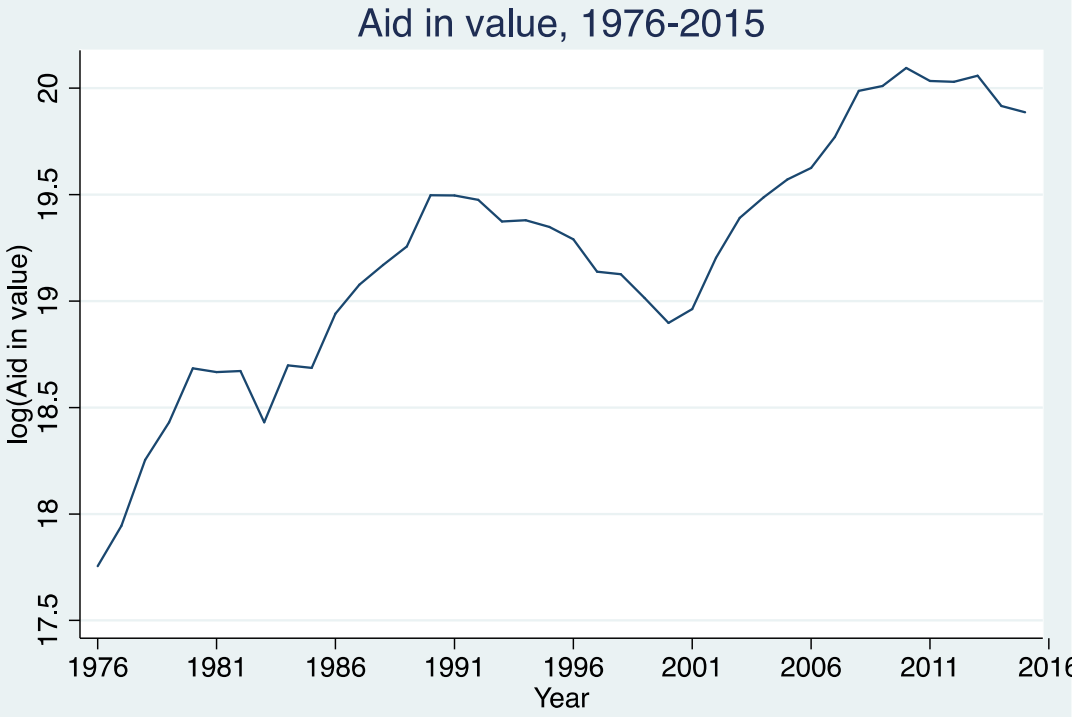
4.1.4. Aid and Economic growth

4.1.4.1. Time Trend

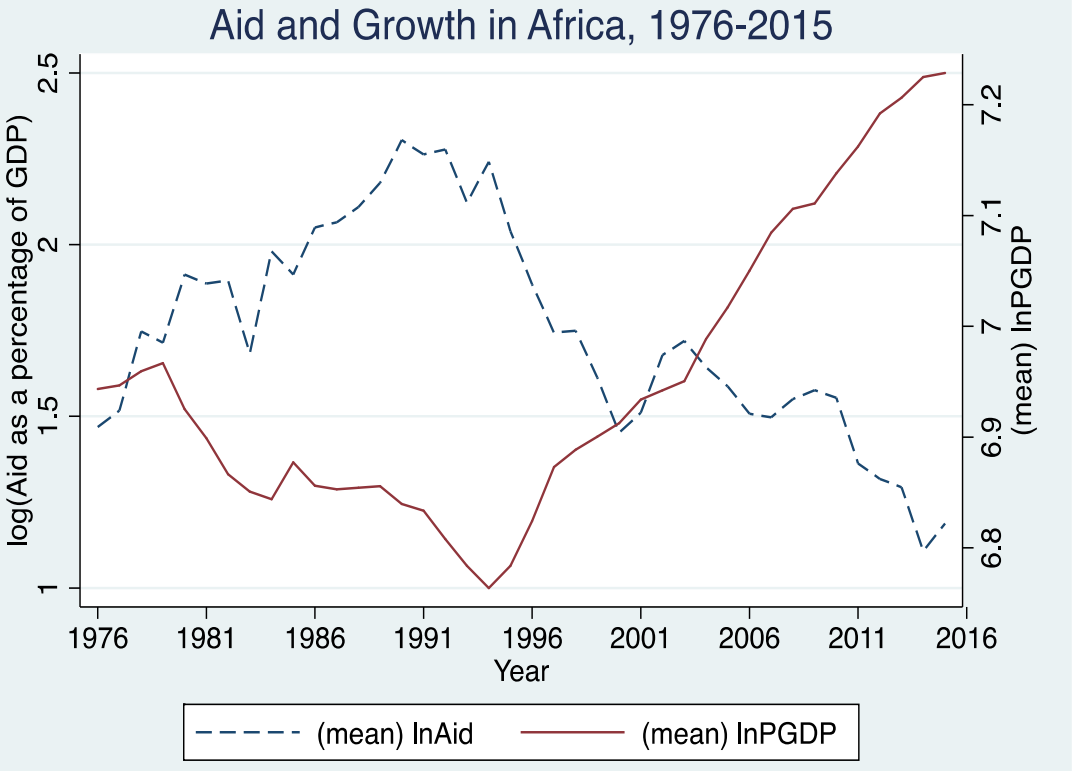
As discussed in the literature review, different studies have reached different conclusions regarding the effectiveness of aid in boosting economic growth. However, a pattern of shift from looking at its effectiveness alone to factors which can make aid effective can be observed in the empirical literature.

The figure below is drawn using log of aid as a percentage of GDP and log of GDP per capita for 48 African countries for which data for the variables are available. The source of data is the World Bank Database, World Development Indicators 2017 edition. The following figure treats all the 48 countries in the continent as one economy.

Figure 4 – Aid in value, and Share of aid from GDP and per capita GDP, 1976-2015 average



Source: Author's computation using World Development Indicator, 2017



Source: Author's computation using World Development Indicator, 2017

For the time stretching from 1976 to 2015 the mean values of the two variables for all African countries seems to work in opposite direction. Though the level of aid flow to African countries still increases, the share of Aid from the total GDP has shown a decline for almost all the period of the study. On the other hand, the change in GDP per capita is unsatisfactory since the growth of per capita GDP dwells in a single digit.

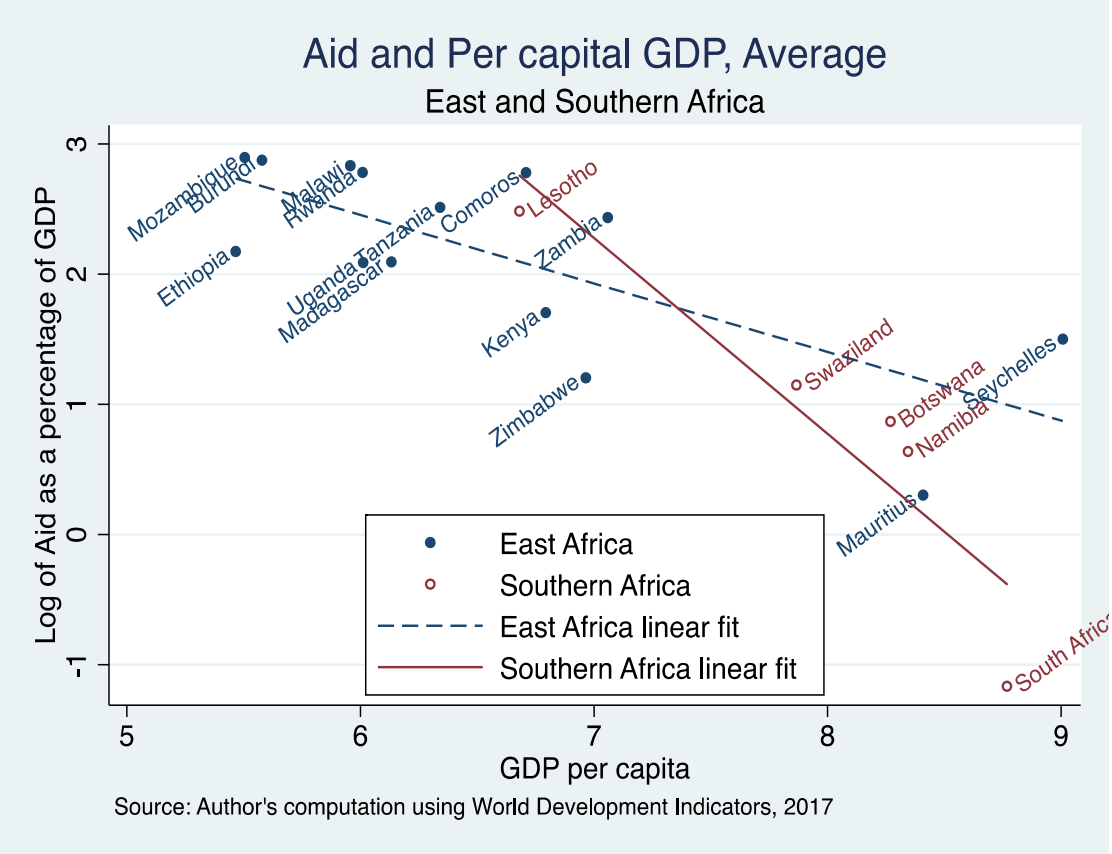
The share of aid shows an increase, with a volatile amount, from 1976 up until the beginning of the 1990s. In contrary, in this time frame the level of per capita GDP declines sharply reaching the lowest point in the sample period.

The first and second figures confirms Easterly (2003)'s conclusion that the growth of African countries shows no improvement despite the increase in Aid. He further noted that by promising a better time in the near future the aid bureaucracies attempt to finesse the above condition. The paper quotes different works of World Bank which stretches more than two decades only with apparently empty catchphrase of "better times are around the corner".

4.1.4.2. Country heterogeneity

The following figure presents the 40 years average of share of aid from per capita GDP and per capita GDP for each country. The figures are drawn separately for non-other than clarity purpose.

Figure 5 – Share of aid from GDP and per capita GDP, East and Southern Africa



In the above figure the aid and per capita GDP relationship in East and Southern Africa is depicted. In this graph, most of the countries with high percentage of aid in their GDP are the East Africa Countries. Countries like Mozambique, Burundi and Ethiopia have a large share of Aid in their GDP and lower per capita GDP. In contrary, the share of aid in GDP is lower in Southern Africa and the per capita GDP is higher. South Africa has the lowest share of aid from GDP and the highest per capita GDP among Southern African countries.

All in all, the figure shows that, countries with high share of aid from their GDP have low per capita GDP and this is true for both regions with some exceptions.

Figure 6 – Share of aid from GDP and per capita GDP, North and Central Africa

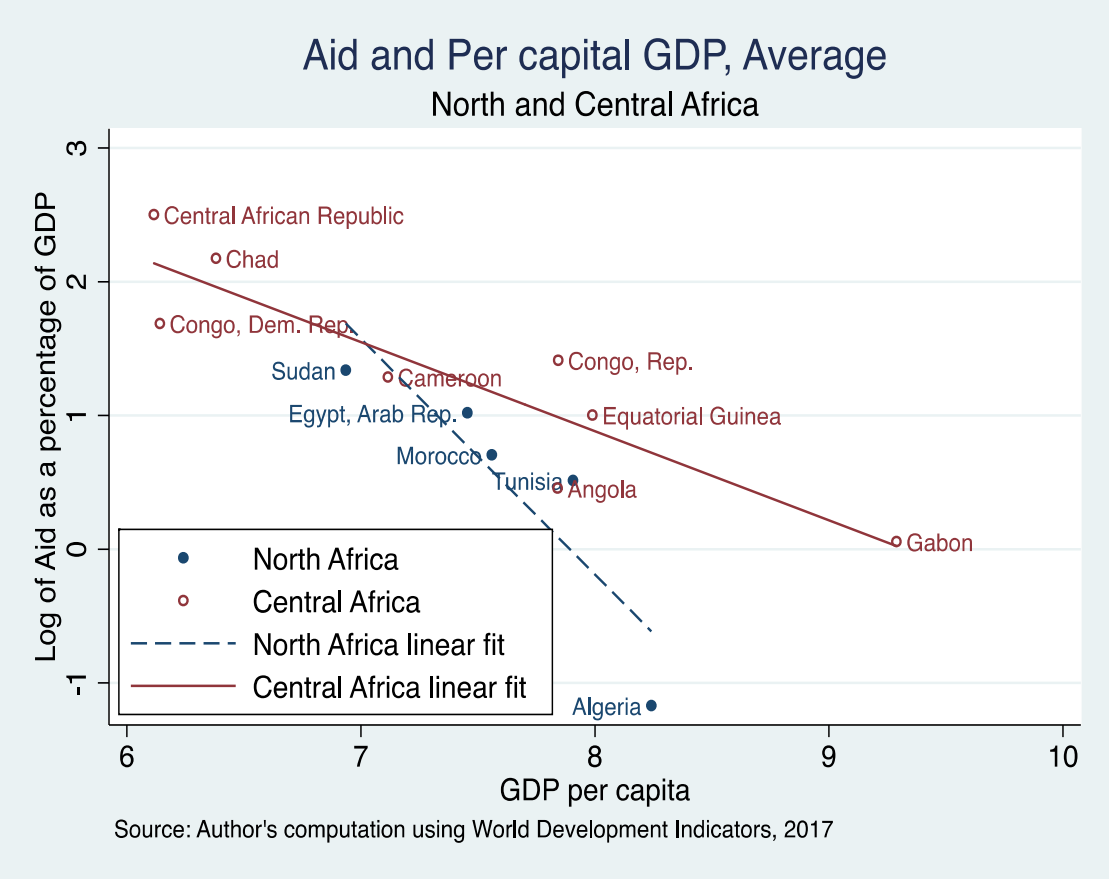
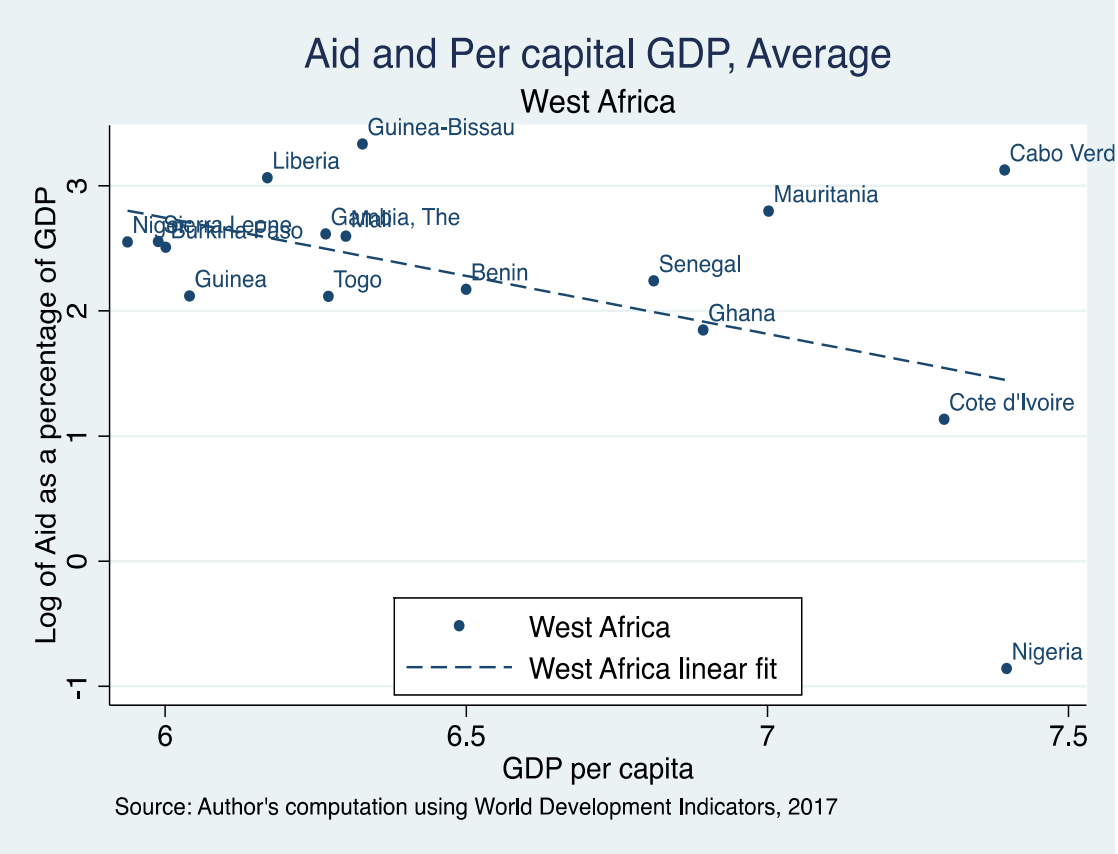


Figure 6 shows the North and Central African countries share of aid from GDP and GDP per capita. Like in the figure for East and Southern African countries, most of the countries with low per capita income are countries with relatively high share of aid from their GDP.

The Central Africa countries Chad, Central African Republic, and Congo Democratic Republic are among the countries with high share of aid and low per capita income. The North African countries Sudan, Egypt, Morocco and Tunisia have a lower share of aid and higher per capita GDP combined relative to Central African countries, with the exception of Gabon.

Figure 7 – Share of aid from GDP and per capita GDP, Country average



The last figure, Figure 7, of this series presents West African countries. The nature of this figure is not much different from the East African countries. Most of the West African countries belong to the corner where high share of aid from GDP is combined with low per capita income. Nigeria is the country with the highest per capita GDP and lowest share of aid.

To sum, the above figures show a correlation between the share of aid from GDP and per capita GDP. Generally speaking, most countries with high level of aid have, on average, a low per capita GDP. However, the correlation should not necessarily be interpreted as causation. The correlation can come from the donor countries preference of aid allocation, as Aid is provided for poor countries this case could be the most reasonable. Yet, the correlation can also be caused due to the flow of Aid. As discussed in the literature, Aid can also cause a decline in per capita GDP. As an exception, Figure 7 shows Cabo Verde, Equatorial Guinea and Seychelles having high share of aid in their GDP and high per capita GDP combined.

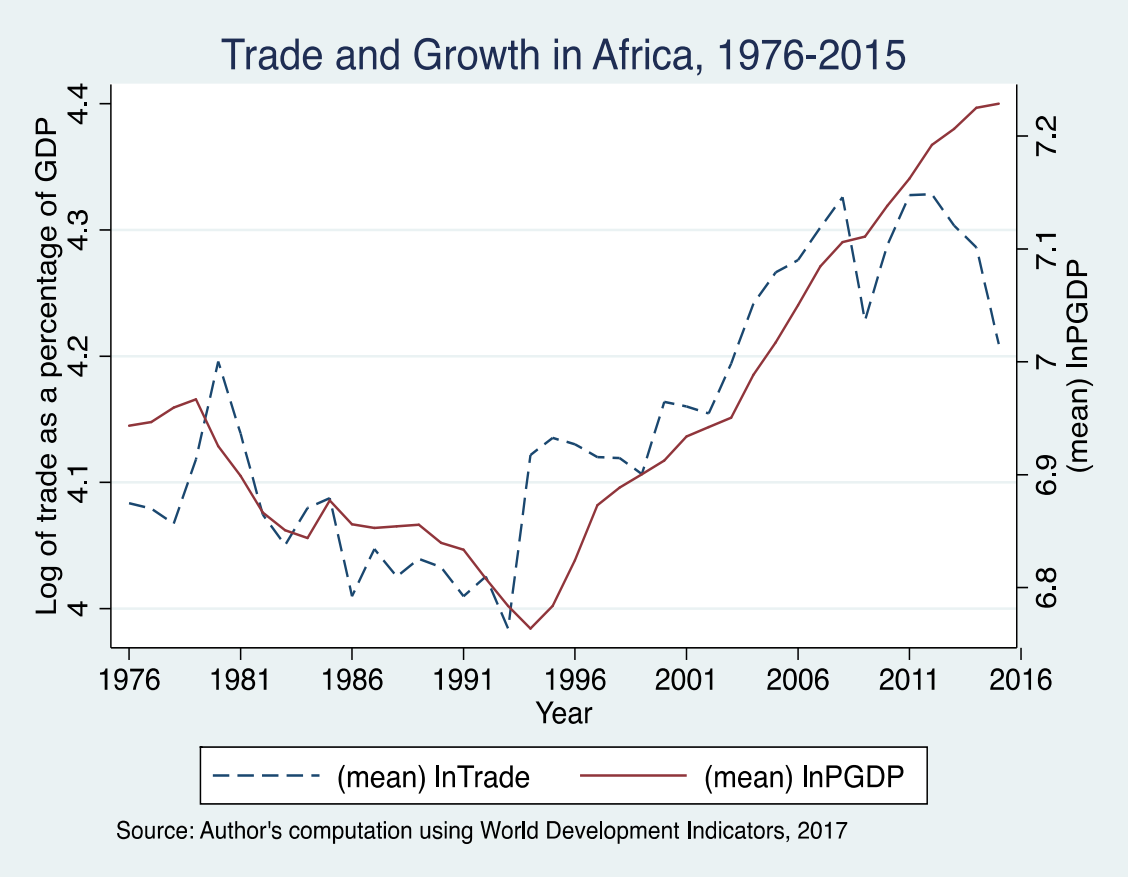
4.1.5. Trade and Economic growth

4.1.5.1. Time Trend

As discussed in the literature, the topic of trade and economic growth is not immune for debate and contrary findings. Figure 8, below, shows the relationship between trade openness, measured as trade per capita of GDP, and per capita GDP.

The figure shows the relationship between Trade, computed by dividing the sum of exports and imports to GDP and per capita GDP over time. In the figure, all the countries are treated as one country and the values in each year are the sum of the 48 countries in the study.

Figure 8 – Trade and per capita GDP, 1976-2015 average



Even though openness shows more volatility than per capita GDP, in contrary to the share of Aid and per capita GDP (see Figure 1), the overall positive relationship is evident in Figure 8. It is worth noting that both GDP per capita and

the share of trade as a percentage of GDP take off around the same year. The growth takeoff in the 1990 and the accompanying increase in openness have been discussed by many studies.

One of the possible explanations for this is African countries market-oriented economic policy reform and liberalization devised dictated by international financial institutions in the 1980s, and the deeper actions towards it undertaken in the 1990s. In addition, the adjustments on market friendly investment policy and institutional change may have worked in countries advantage. In this regard, Sundaram and Von Arnim (2008) argued that the improvement in the performance of the economy in the 1990s is associated with ´the liberalization of trade, the devaluation of currency undertaken by the developing countries which assisted businesses to be competitive and promote export, and privatization policies.

Moreover, according to Outlook (2015), the twenty-year long sustained and strong growth in Sub-Saharan Africa started in the mid-1990s for different reasons. The authors suggested that strengthening of economic and political institutions and the exit of a number of countries from fragility accompanied with sound macroeconomic policies implemented by the authorities in the region resulted in the take-off. On the other hand, the conditions outside the countries such as high demand in the developed countries up to the global financial crisis and the demand for raw materials from emerging countries, mainly China, afterwards played a huge role.

The mid-2008s where openness in the above figure shows a decline is characterized by the global economic crisis. The crisis started with housing market bubble resulting in a decline in lenders confidence and halt in credit flows in the U.S., which was later translated into economic and financial crisis in many parts of the world. The banks in Africa hold few of the “toxic assets” which leads to the crisis. And as the continent was not much exposed to the global financial system, the impact of the crisis was expected to be negligible. However, the reality was far from the expectation as the crisis exerted a strong negative effect. It affected the

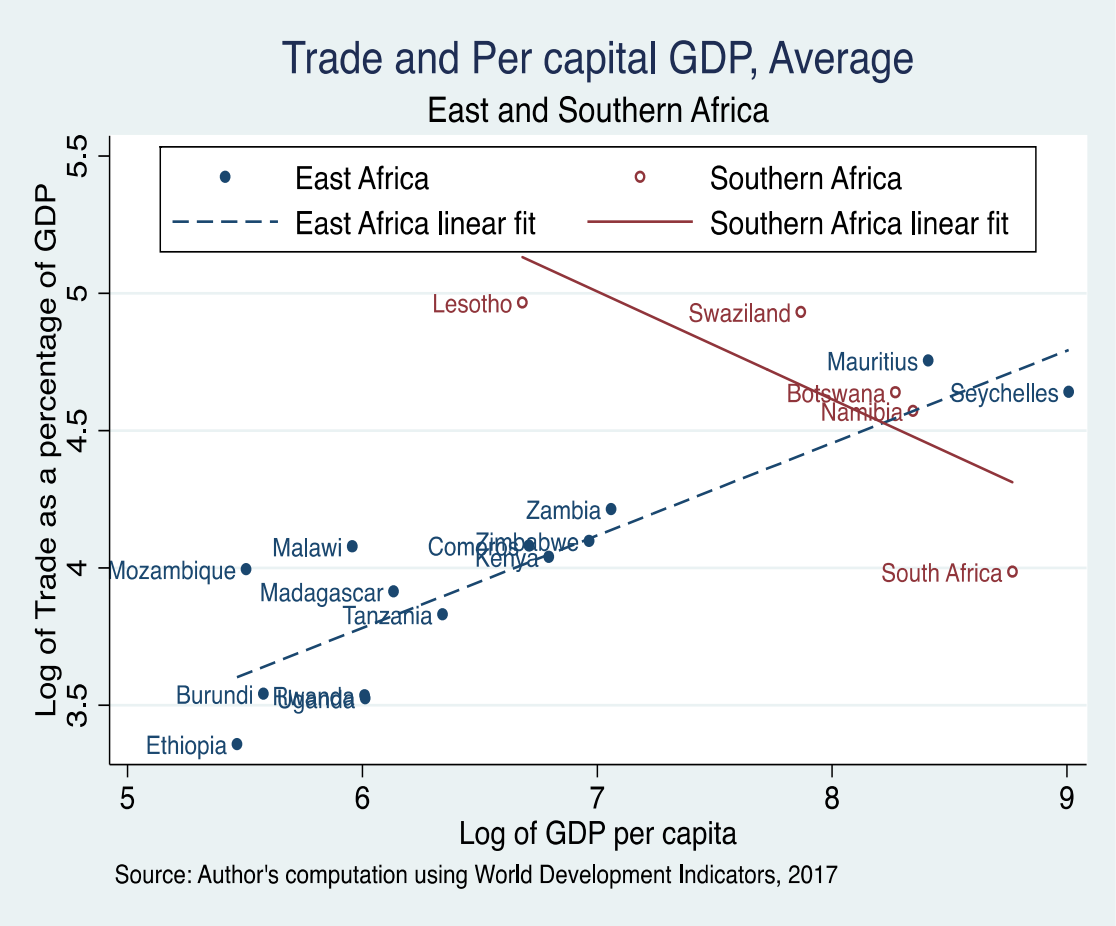
continent by reducing demand for the export commodities of African countries, reducing foreign aid and remittances, provoking a decline in foreign direct investment, and causing financial conditions outside the continent to become tighter (Arieff et al. 2010).

Similarly, Devarajan and Kasekende (2011) noted that the global economic and financial crisis hit the African countries with a lag and hinders the momentum in their growth. Even after many countries coup up from the global economic recession, its impact on Africa continues to deepen. Contrary to developed countries, the crisis affects African countries through the real channel rather than the financial channel. It affects foreign direct investment, export, and remittances.

4.1.5.2. Countries heterogeneity

The figures below are drawn using the 40 years average of each country openness and per capita GDP. Like the Aid and per capita GDP figure the countries are divided into groups only to avoid too many overlaps in the label.

Figure 9 –Trade and per capita GDP, East and Southern Africa



The above figure provides intriguing information. For East Africa, most of the economies with low average openness in the past four decades have a low per capita GDP. On one corner, countries like Ethiopia, Burundi, Uganda, and Ruanda are among the countries with low openness and low per capita GDP. Besides, per capita GDP increases as the economy becomes more and more open to international trade. Countries like Mauritius and Seychelles are examples of this fact. However, Southern African countries like Lesotho and Swaziland, with a large share of trade in their GDP experience low per capita GDP relatively to South Africa, which exhibits far less openness. These facts are revealed on the slope of the fitted values.

Figure 10 –Trade and per capita GDP, North and Central Africa

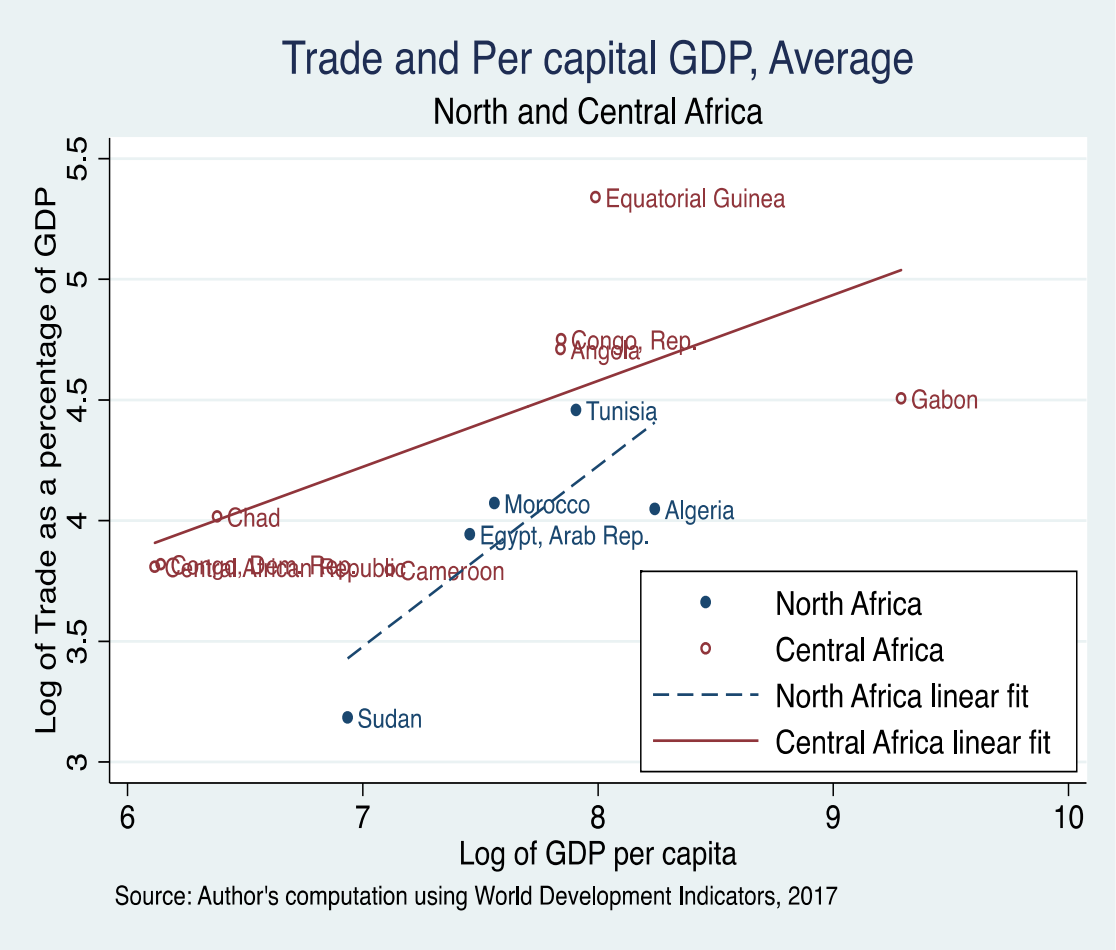
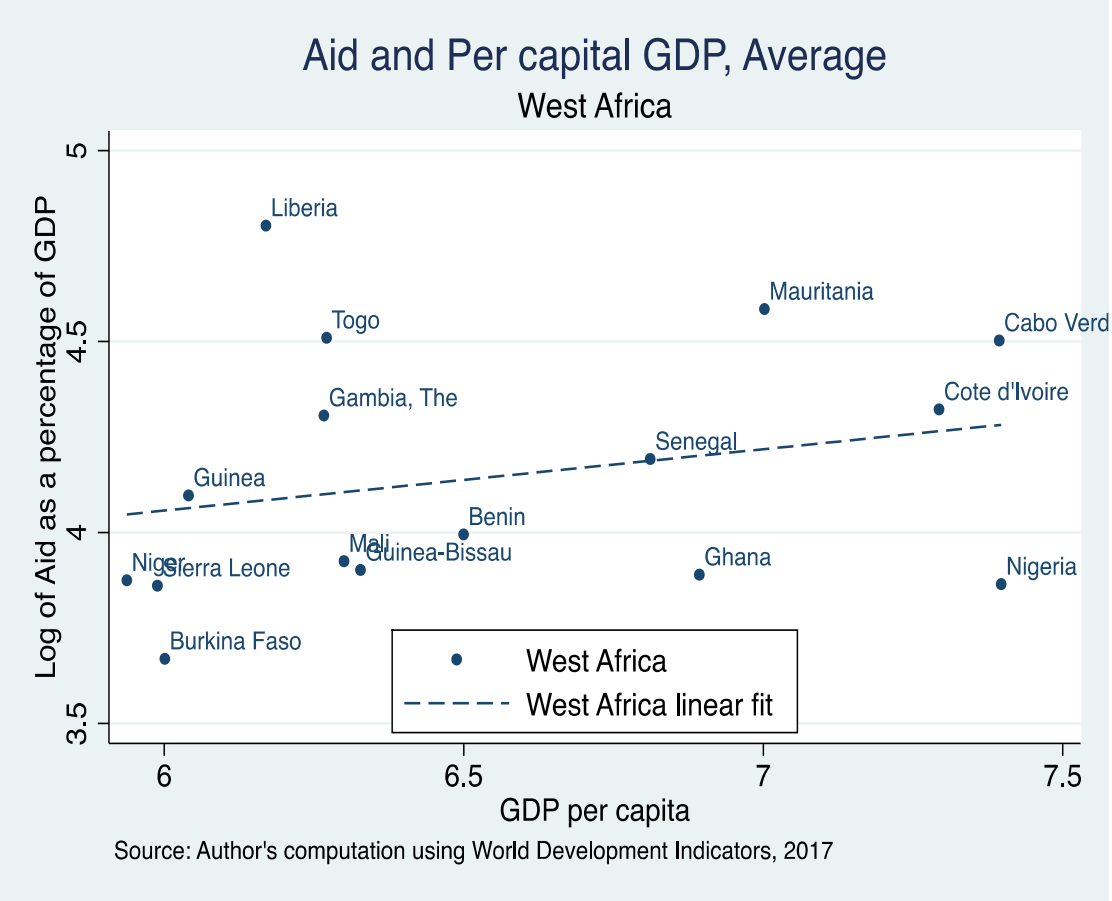


Figure 10 represents North and Central Africa and has a similar nature as the East African countries. Yet, this figure also shows a fascinating trend. The Central African countries like Cameroon, Chad, Congo Democratic Republic, and Central Africa Republic experience far less per capita GDP than the North African countries Morocco, Egypt, and Algeria. However, they have a relatively low difference in openness to international trade among the countries in the regions. Whereas, the West African country Gabon has the largest per capita GDP and comparably equal openness to international trade with the North African countries. Congo Republic and Angola from Central Africa and Tunisia from North Africa have the most open economy. Sudan, nevertheless, has a better per capita GDP than some Central African countries whose economy is more open.

Figure 11 –Trade and per capita GDP, West Africa



The West African countries in the above figure have essentially the same nature of relation with the region other than Southern Africa. The less open countries like Burkina Faso, Sierra Leone and Niger have less per capita GDP compared to countries like Mauritania and Cabo Verde.

In conclusion, two of the largest economies in Africa, Nigeria and South Africa, have a relatively low share of trade in their GDP. Despite some differences explained above, it is quite clear that most countries with larger share of trade in their GDP have a larger per capita income. In addition, even in the Southern African countries, except for South Africa, the relationship between openness of the economy and the per capita GDP is not different from the other regions.

Chapter five

5. Empirical Results and Discussion

5.1. Cross-country analysis

In this section, the Solow model and the augmented neoclassical growth model developed by MRW are estimated. After strictly following the estimation procedure used in MRW, the same model is estimated by incorporating the main variables considered for the present research study: official development assistance or aid and trade (measured by openness of the economy). For the estimation, data over the period 1976-2015 obtained from World Bank Development Indicators are used. The main objective of this cross-country growth regressions analysis is to check the validity of the Solow and the augmented neoclassical growth model by using a different sample period, number of countries as well as additional variables. The analysis uses 48 African countries under the sample Africa, 44 countries under Sub-Saharan Africa and 16 countries under COMESA. The list of countries used in the analysis is provided in the appendix.

5.1.1. Text book Solow model

According to the neoclassical growth model of Solow the steady state level of per capita income depends negatively on the population growth rate, and positively on the saving or the investment rate. The model assumes technological progress, saving, and population growth are exogenous and labour and capital are paid their marginal product (Mankiw et al. 1992). Thus, the steady state per capita income is as defined in equation 3.17

$$\ln\left(\frac{Y_{2015}}{L_{2015}}\right) = a + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n+g+\delta) + \varepsilon \qquad (3.17)$$

Given the assumption that marginal product is the payment for labor and capital, the model is expected to predict the magnitude as well as the sign of the parameters of population growth and saving. The elasticity of per capita GDP with

respect to $(n + g + \delta)$ and saving rate are expected to be 0.5 and – 0.5, approximately. The estimation provided below follows the assumption of MRW that g and δ are constant and equal to 0.05 across country. The regression is estimated by OLS as the model assumes the population growth rate and saving rate are independent of the error term. See Mankiw et al. (1992) for potential reasons.

The data set in the below estimation incorporates annual data of gross capital formation used as a proxy for investment and sum of population growth, technological progress and depreciation averaged for the sample period 1976-2015. The dependent variable is the log of GDP per capita in 2015. In order to investigate the Solow model's assumption that higher saving leads to higher per capita income and higher level of $n + g + \delta$ leads to lower per capita income the following estimation is performed.

Table 3 – Replication of the Solow model

Dependent variable: log of GDP per capita 2015			
Sample	African Countries	SSA	COMESA
Observations	48	44	16
Constant	0.649 (4.125)	0.957 (4.484)	-1.3898 (6.686)
lnGCF	1.8072 ** (0.347)	1.791** (0.372)	2.796** (0.917)
$\ln(n + g + \delta)$	-3.637* (1.545)	-3.502** (1.699)	-5.077** (2.142)
Adj R-squared	0.436	0.394	0.744
F-statistics	19.18	14.98	22.82
s.e.e	0.83	0.866	0.59
Restricted regression:			
Constant	5.227** (0.351)	5.255** (0.373)	3.958** (0.48)
$\ln GCF - \ln(n + g + \delta)$	1.954** (0.322)	1.904** (0.353)	3.408** (0.502)
Adj R-squared	0.433	0.395	0.751

s.e.e	0.83	0.865	0.581
Test of restriction:			
p-value	0.271	0.342	0.437
Implied α	0.66	0.656	0.773

Source: Own elaboration.

*Note: * Significant at 10% ** Significant at 5% *** Significant at 1%. Standard error is provided in parenthesis. GCF and Population growth are average for the period 1976-2015. And $g + \delta$ is assumed to be 0.05.*

Like Mankiw et al. (1992), from the results in the above table we can infer that the assumption of the Solow model which states the steady state per capita GDP is associated negatively to population growth and positively to saving rate is validated. The coefficients are significant for the sample of the 48 African countries as well as for the sub-sample of 44 Sub-Saharan Africa countries and the 16 member countries of COMESA.

The other assumption that is not rejected in the above estimation is the coefficient of log of $(n + g + \delta)$ and log of saving or gross capital formation, which are opposite in sign and equal in magnitude. This is because the p-values are 0.2711, 0.3418 and 0.4370 for Africa, Sub-Saharan Africa and COMESA member countries, respectively. In addition, the above result confirms that a fairly large portion of cross-country disparity in income per capita is explained by the difference in population growth and saving. The explanatory power of the variables is higher in the sample of COMESA member countries with an adjusted R square of 0.75 than the sample of Africa with adjusted R square of 0.43 and Sub-Saharan Africa with adjusted R square of 0.39.

To sum, the table indicates that a 1% increase in saving (GCF) is expected to increase GDP per capita of 2015 by 1.8% for Africa ,1.79% for Sub-Saharan Africa, and 2.79% for COMESA member countries. Besides, a 1% increase in population growth is expected to decrease the GDP per capita of 2015 by 3.6%, 3.5% and 5% for Africa, Sub-Saharan Africa and COMESA member countries, respectively.

5.1.2. Mankiw, Romer, and Weil

The following part deals with the augmented neoclassical growth model of Mankiw, Romer, and Weil. Human capital has a paramount significance in the growth process. MRW stated that ignoring this variable would lead to incorrect conclusions. But, they also indicated that the addition of this variable can alter the empirical analysis or theoretical modeling of economic growth. The table below presents the regression estimate of

$$\ln\left(\frac{Y_{2015}}{L_{2015}}\right) = a + \frac{\alpha}{1-\alpha}\ln(S_k) + \frac{\beta}{1-\alpha}\ln(S_h) - \frac{\alpha}{1-\alpha}\ln(n+g+\delta) + \varepsilon_t \quad (3.22)$$

Where $\ln\left(\frac{Y_{2015}}{L_{2015}}\right)$ is the log of GDP per capita in 2015, $\ln(S_k)$ is the log of Gross capital formation, $\ln(S_h)$ is the log of secondary school enrolment ratio, and $\ln(n+g+\delta)$ is the sum of population growth, technological progress and depreciation.

Table 4 – Replication of the Mankiw, Romer and Weil

Dependent variable: log of GDP per capita 2015			
Sample	African Countries	SSA	COMESA
Observation	48	44	16
Constant	6.295* (3.446)	6.223 (3.706)	0.328 (6.296)
lnGCF	1.348*** (0.289)	1.36*** (0.307)	2.233** (0.912)
ln(n + g + δ)	0.116 (1.42)	0.127 (1.528)	-3.253 (2.251)
lnSCHOOL	1.025*** (0.196)	1.067*** (0.212)	0.612 (0.352)
Adj R-squared	0.645	0.6192	0.7787
s.e.e	0.66	0.69	0.55
Restricted regression:			

Constant	0.917 (0.893)	0.677 (0.991)	1.201 (1.436)
$\ln GCF - \ln(n + g + \delta)$	1.282*** (0.291)	1.306*** (0.31)	2.309*** (0.710)
$\ln SCOOL - \ln(n + g + \delta)$	0.856*** (0.168)	0.897*** (0.185)	0.631* (0.313)
Adj R-squared	0.63	0.61	0.795
s.e.e	0.671	0.698	0.526
Test of restriction:			
p-value	0.317	0.343	0.717
Implied α	0.408	0.408	0.586
Implied β	0.273	0.280	0.160

Source: Own elaboration.

*Note: * Significant at 10% ** Significant at 5% *** Significant at 1%. Standard error is provided in parenthesis. GCF, School, and Population growth are average for the period 1976-2015. And $g + \delta$ is assumed to be 0.05.*

The estimation results in the above table show that human capital and investment are the variables which will have a sizable impact on per capita GDP growth of 2015. The inclusion of human capital in the second estimation improves the predictive capacity of the model. The improvement is revealed in the adjusted R square. The adjusted R square for the first estimation was 0.43, 0.39, and 0.75; in the second estimation it is 0.63, 0.61, and 0.795, for Africa, Sub-Saharan Africa, and COMESA member countries, in successive order.

In addition, the p-value of the restriction indicates that the assumption that the sum of the coefficient of ln(GCF), $\ln(n + g + \delta)$, and lnSCHOOL is equal to zero is not rejected. The validity of the restriction applies to both the sample and the two sub-samples of the study.

Parallel to the regression of MRW the variable $\ln(n + g + \delta)$ is not significant in the model with human capital for all the three samples. However, unlike MRW, the value of investment (lnGCF) is highly significant. Investment has higher estimated impact in COMESA member countries with a 1% increase in

investment resulting a 2.23% increase in GDP per capita. A 1% increase in investment also increases the per capita income of Africa and Sub-Saharan Africa by 1.35% and 1.36%. Moreover, human capital (lnSCHOOL) is statistically significant for two of the three samples. As shown in table 4, a 1% increase in human capital improves the per capita income of Africa by 1.02% and the Sub-Saharan Africa by 1.06%.

5.1.3. Adding Aid and Trade

As discussed in the previous section of this study, given the enormous amount of aid flowing to African countries and the vital importance of trade, growth discussions ignoring those variables would be incomplete. To account for the two variables the model is specified as follows

$$\ln\left(\frac{Y_t}{L_t}\right) = a + \frac{\alpha}{\psi}\ln(S_k) + \frac{\beta}{\psi}\ln(S_h) + \frac{\theta}{\psi}\ln(S_o) + \frac{\gamma}{\psi}\ln(S_t) - \frac{\alpha+\beta+\theta+\gamma}{\psi}\ln(n+g+\delta) + \varepsilon_i \qquad (3.29)$$

Where $\ln\left(\frac{Y_t}{L_t}\right)$ is the log of GDP per capita in 2015, $\ln(S_k)$ is the log of Gross capital formation, $\ln(S_h)$ is the log of secondary school enrolment ratio, $\ln(S_o)$ the log of aid, $\ln(S_t)$ the log of trade, and $\ln(n+g+\delta)$ is the sum of population growth, technological progress and depreciation.

Table 5 – Further augmented model

Dependent variable: log of GDP per capita 2015			
Sample	African	SSA	COMESA
Observations	48	44	16
Constant	5.475* (2.876)	5.991** (2.744)	6.574 (6.131)
lnGCF	1.248*** (0.262)	1.576*** (0.267)	2.613*** (0.819)
$\ln(n+g+\delta)$	-0.596	-1.076	-1.720

	(1.086)	(1.050)	(2.07)
lnSCHOOL	0.282 (0.1963)	0.204 (0.194)	-0.017 (0.404)
lnTrade	0.542** (0.219)	0.386* (0.218)	0.426 (0.3715)
lnAid	-0.522*** (0.091)	-0.662*** (0.096)	-0.588** (0.263)
Adj R-squared	0.7955	0.8250	0.8326
s.e.e	0.50014	0.4653	0.47589
Restricted regression:			
Constant	3.485** (1.412)	5.123*** (1.404)	5.073* (2.754)
$\ln GCF - \ln(n + g + \delta)$	1.220 (0.258)***	1.570*** (0.263)	2.487*** (0.652)
$\ln SCOOL - \ln(n + g + \delta)$	0.198 (0.165)	0.165 (0.162)	-0.032 (0.383)
$\ln Trade - \ln(n + g + \delta)$	0.559** (0.217)	0.391* (0.215)	0.3996 (0.344)
$\ln Aid - \ln(n + g + \delta)$	-0.538*** (0.089)	-0.671*** (0.091)	-0.581** (0.250)
Adj R-squared	0.7973	0.8289	0.8466
s.e.e	0.498	0.46012	0.45548
Implied α	0.500	0.639	0.7596
Implied β	0.081	0.067	0.0799
Implied θ	0.229	0.159	0.122
Implied γ	-0.22	-0.219	-0.177

Source: Own elaboration.

*Note: * Significant at 10% ** Significant at 5% *** Significant at 1%. Standard error is provided in parenthesis. GCF, School, aid, trade, and Population growth are average for the period 1976-2015. And $g + \delta$ is assumed to be 0.05.*

Like the addition of human capital, the inclusion of aid and trade in the model also generated a magnitude as well as a sign change in the variables. The human capital measurement proxy school and the log of $(n + g + \delta)$ become statistically insignificant for all the three samples. However, Gross capital formation has a positive and highly significant estimated effect. A 1% increase in

lnGCF has an estimated positive impact of 1.248%, 1. 576%, and 2.613% on Africa, Sub-Saharan Africa and COMESA member countries per capita GDP in 2015.

The additional variables improved the explaining power of the model. To put this in perspective, the adjusted R square for the second estimation was 0.63, 0.6 and 0.795, in the third estimation the adjusted R square becomes 0.7955, 0.8250, and 0.8325 for Africa, Sub-Saharan Africa, and COMESA member countries, in successive order.

In addition, the variable trade has a positive and significant estimated effect on the per capita GDP of the Africa sample. A 1% increase in trade increases the per capita GDP by 0.542%. The variable aid which is measured as a share of official development assistance from GDP has a negative and highly significant effect on per capita GDP. A 1% increase in Aid has an estimated negative impact of 0.52%, 0.66%, and 0. 587% for the samples in order.

5.2. Panel data estimation

In this section, and in order to take advantage of the longitudinal nature of the data, we estimate our baseline model defined in equation (3.33) using a fixed effects (FE) approach that allow us to account for country (permanent) unobserved heterogeneity. Moreover, to address the missing value problem, this study uses a 5 years average between 1976 and 2015, output is measured by GDP per capita at constant U.S. Dollar 2010; saving or investment is measure by gross capital formation average for 5 years, population growth and the human capital proxy secondary school enrolment ratio are also computed as averages for 5 years. In addition, the MRW assumption of the sum technological progress and depreciation equals to 0.05 holds for this study as well. Finally, a dynamic model for GDP per capita that writes as:

$$\begin{aligned}\ln Y_{i,t} - \ln Y_{i,t-1} &= \gamma_0 + \gamma_1 \ln Y_{i,t-1} + \gamma_2 \ln\left(n_{i,t} + g + \delta\right) + \gamma_3 \ln S_{k_{i,t}} + \gamma_4 \ln S_{i,h_{i,t}} \\ &+ \gamma_5 \ln Aid_{i,t} + \gamma_6 \ln Trade_{i,t} + \varepsilon_{i,t} \qquad (3.33)\end{aligned}$$

is also estimated using the two step Difference GMM (DIF-GMM) and the two step system GMM (SYS-GMM) (e.g., Arellano and Bond, 1991 and Arellano and Bover, 1995). The results are presented in Table 6.

Table 6 – Panel data estimations

Dependent variable $\Delta lnPGDP_{i,t}$				
Estimation	POLS	FE	DIF-GMM	SYS-GMM
Observation	285	285	172	240
$lnPGDP_{i,t-1}$	-0.095***	-0.175***	0.031	0.142
	(0.016)	(0.041)	(0.10)	(0.11)
lnGCF	0.168***	0.085**	0.125***	0.163***
	(0.021)	(0.029)	(0.029)	(0.04)
$\ln(n + g + \delta)$	-0.008	-0.004	0.022	0.040
	(0.022)*	(0.029)	(0.034)	(0.038)
lnSchool	0.048**	0.071**	-0.005	-0.060
	(.0166)	(0.022)	(0.040)	(0.052)
lnAid	-0.040***	-0.071***	-0.047	-0.032
	(0.011)	(0.017)	(0.037)	(0.024)
lnTrade	0.084***	0.148***	0.146***	0.145**
	(0.023)	(0.039)	(0.044)	(0.065)
Constant	0.564***	0.689**	-0.247	-
	(0.145)	(0.341)	(0.321)	
Adj. R^2	0.355	-	_	_
Sargan test P-value	NA	NA	0.4704	0.8213

Source: Own elaboration.

*Note: * Significant at 10% ** Significant at 5% *** Significant at 1%. Robust Standard errors are provided in parenthesis.*

In the OLS and fixed effects estimations the Solow and MRW conclusions about the sign of the variables are confirmed in the table above. Population growth has a negative sign and GCF has a positive coefficient as suggested by Solow. The variable school also shows the expected positive sign.

Like the cross-sectional regression the Pooled OLS estimation above also confirms that the share of aid from GDP has a significant negative effect on per capita GDP. This finding contradicts the finding of Hansen and Tarp (2001) that aid increases per capita income in all prospect, and partly support Boone (1996) and Ferreira and Simões (2013). However, when the model is estimated using System and Difference GMM the variable aid becomes, though still negative, insignificant. Thus, the fining of this dissertation regarding aid is in full support of Rajan and Subramanian (2008). The dissertation found no consistent effect of aid on economic growth.

Trade has a positive and significant effect in the panel data estimations performed above as it has in the cross-sectional estimation. The impact of trade on economic growth has been consistently positive and highly significant in OLS, fixed effect, twostep system GMM as well as twostep Difference GMM estimations. This results support the findings of (Brueckner and Lederman (2015) that openness to international trade promotes economic growth.

The value of Sargan, overidentifying restrictions test, reported in the above table indicates that the instruments are valid in both the twostep difference and system GMM. Table 7 presents the results of the test for serial correlation in the residuals in first differences. According to the test statistics, at the 1 and 5% level of significance we do not reject the null of no serial correlation of order 1, 2, and 3 validating the consistency of the GMM estimators.

Table 7 – Arellano-Bond test for zero autocorrelation in first-differenced errors

Order	Difference GMM		System GMM	
	z	Prob > z	z	Prob > z
1	-1.312	0.1895	-1.4726	0.1409
2	-0.0437	0.9651 |	0.39057	0.6961
3	-1.7975	0.0723	-1.743	0.0812

As it is shown in Table 7, the regression of both system and difference GMM

has no autocorrelation in first difference in first, second or third order. This is because the test result does not allow the rejection of the H0; there is no autocorrelation in first difference.

Chapter 6

Conclusions

This study is conducted in an endeavor to compare and contrast two of the most debated topics of economics, the flow of aid and openness to international trade. As discussed in the literature review, both topics attracted many researchers to examine their impact namely on economic growth. Nonetheless, in the extended years of research in both topics researchers, couldn't come in to agreement neither on effectiveness of Aid nor on the impact of Trade.

Researches related to aid have been evolving from indirect assessment of the impact of aid on growth through saving and investment, assessing the impact of aid on growth directly, and currently to its conditionality. Some researchers found conditions under which the flow of aid can be used in such a way that it promotes economic growth. The conditionality for aid to be effective, recommended by those researchers, ranges from economic policy to climatic conditions. Some other researchers found no evidence to support neither the effectiveness of aid nor conditions in which it can work better. Likewise, trade has also been an area of disagreement and conflicting conclusions. One side of the argument is that international trade contributes to the economic growth and distribution of income. The other side argues that due to the composition of export of African countries the impact of trade on growth is negative.

This study, however, rather than testing the same hypothesis of single variable, which will only be addition to the pile of researches on the area, aimed to study both topics. Hence, the main theme of the study is testing which variable performed better towards contributing to economic growth of African countries.

Modeling the equation in such a manner that the economy is best explained when the study's variables are included has a paramount importance. Therefore, the Solow model which have been found to be fairly explanatory to why some countries are poor and some other are rich is chosen as a base equation. In order

to check if this explanatory power is strong enough to explain the growth situation in Africa, the Solow model is estimated following the same assumptions. And the study found the expected signs of Solow in the main sample of the 48 countries, the sub-sample of 44 countries in sub-Saharan Africa as well as the 16 member countries of COMESA. Subsequently, a regression of Mankiw, Romer, and Weil have been conducted. The augmented Solow model of Mankiw, Romer, and Weil incorporates human capital in addition to the Solow model variables saving and population growth.

Finally, after testing the validity of the Solow and the augmented Solow model further augmentation to add the variables Aid and Trade have been implemented. The further augmentation is more realistic as it considers an open economy and allows open economy variables to affect the level of output. However, given the growing interest in GMM and other benefits mentioned in the study the model is also estimated following this method. The GMM estimation reports are a twostep estimation results of difference GMM and system GMM.

The results of the Solow concur with the assumption of Solow that output is negatively related with population growth and positively related with saving. And augmented Solow model also confirms the finding of MRW, that human capital contributes positively to economic growth. The last and most important cross-country regression table presents the variable aid which has a significant negative impact on per capita GDP. The negative impact is consistent in all the three samples considered under the cross-country regression. The inclusion of the additional variables not only enables to assess the open economy scenario of Solow model but also improve the explanatory power of the model. The table also presents the impact of Trade on per capita GDP. Trade has a positive and significant effect on the 48 African countries and 44 Sub-Saharan Africa countries. But although it is positive the impact of trade on per capita GDP in COMESA member countries is insignificant.

Moreover, in the OLS and fixed effect model estimation the impact of aid is negative and highly significant. However, in the same table the system and

difference GMM reports shows a negative but insignificant effect of aid on per capita income. The impact of trade on economic growth on the other hand have been consistently positive and highly significant in OLS, fixed effect, twostep system GMM as well as twostep Difference GMM estimations.

In sum, leaving the debate of effectiveness of single variable aside, the dissertation provides plausible information as it pertains to which of the variable among the contested issues performed better. The results of this dissertation show that Trade plays an important positive role in African economy and although arguable Aid has a negative impact. A most important research with a conclusion very close to this study is one conducted by (Adam and O'Connell 2004). The researchers concluded that switching from aid to trade improves the welfare of developing countries. Hence, focusing on trade relations and how to better trade is an appealing area of attention than what seems to be a search for excuses to justify the inconsistent performance of Aid by the mavens.

The main study suggests that any government or organization in a pursuit of contributing towards better economic growth in Africa should focus more so on creating a better environment for the countries to trade rather than providing aid. Policy makers in African countries should focus on promoting export, easing on business regulations, minimizing start up time and supporting the small and medium enterprises which have proven to be the main employment nucleus in those countries. However, if the case is as Boone (1996) suggested and the officials in the recipient country has no interest in avoiding distortionary policy, donor countries can promote to growth by reducing unnecessary restrictions on export of African countries such as standards and other non-tariff barriers, tariffs and quota.

Due to lack of data the impact of aid and trade on other crucial development issues like gender and rural urban inequality and the validity of the implied alpha results are not included in this dissertation. The researcher recommends further research in areas stated above in order to have a full picture of the impact of the two variables.

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Appendices

Africa		Sub-Saharan Africa		COMESA
Algeria	Rwanda	Angola	Sierra Leone	Burundi
Angola	Senegal	Benin	South Africa	Comoros
Benin	Seychelles	Botswana	Sudan	Congo, Dem. Rep.
Botswana	Sierra Leone	Burkina Faso	Swaziland	Egypt, Arab Rep.
Burkina Faso	South Africa	Burundi	Tanzania	Ethiopia
Burundi	Sudan	Cabo Verde	Togo	Kenya
Cabo Verde	Swaziland	Cameroon	Uganda	Madagascar
Cameroon	Tanzania	Central African Republic	Zambia	Malawi
Central African Republic	Togo	Chad	Zimbabwe	Mauritius
Chad	Tunisia	Comoros	Senegal	Rwanda
Comoros	Uganda	Congo, Dem. Rep.	Seychelles	Seychelles
Congo, Dem. Rep.	Zambia	Congo, Rep.		Sudan
Congo, Rep.	Zimbabwe	Cote d'Ivoire		Swaziland
Cote d'Ivoire	Niger	Equatorial Guinea		Uganda
Egypt, Arab Rep.	Nigeria	Ethiopia		Zambia
Equatorial Guinea		Gabon		Zimbabwe
Ethiopia		Gambia, The		
Gabon		Ghana		
Gambia, The		Guinea		
Ghana		Guinea-Bissau		
Guinea		Kenya		
Guinea-Bissau		Lesotho		
Kenya		Liberia		
Lesotho		Madagascar		
Liberia		Malawi		
Madagascar		Mali		
Malawi		Mauritania		
Mali		Mauritius		
Mauritania		Mozambique		
Mauritius		Namibia		
Morocco		Niger		
Mozambique		Nigeria		
Namibia		Rwanda		